Curriculum 2023

Specialized Subjects (Department of Applied Chemistry and Biotechnology)

	Subject	Credit	Credit per Student Year			Note
			3rd Grade	4th Grade	5th Grade	
1	Experiments in Applied Chemistry and Bioengineering 1	4	4			Required
2	Experiments in Applied Chemistry and Bioengineering 2	4	4			Required
3	Experiments in Applied Chemistry and Bioengineering 3	2		2		Required
4	Experiments in Applied Chemistry and Bioengineering 4	2		2		Required
5	Presentation Skills	1		1		Required
6	Internship A	2		2		Select one subject Required
7	Internship B	1		1		
8	Graduation Study	8			8	Required
9	Engineering Ethics	2			2	Required、Academic Credit
10	Engineering English	2			2	Required
11	Applied Mathematics C	2		2		
12	Probability and Statistics	1		1		
13	Advanced Seminar in Mathematics	2		2		Optional
14	Applied Physics 1	2	2			
15	Applied Physics 2	1		1		
16	Applied Physics 3	1		1		
17	Inorganic Chemistry 1	2	2			
18	Inorganic Chemistry 2	2		2		
19	Organic Chemistry 2	2	2			
20	Bioorganic Chemistry 1	1		1		
21	Bioorganic Chemistry 2A	1		1		
22	Bioorganic Chemistry 2B	1		1		
23	Industrial Bioorganic Chemistry 1	2			2	Academic Credit
24	Industrial Bioorganic Chemistry 2	2			2	Academic Credit
25	Physical Chemistry 1	2	2			
26	Physical Chemistry 2	2		2		Academic Credit
27	Physical Chemistry 3	2		2		Academic Credit
28	Biophysical Chemistry 1	2			2	Academic Credit
29	Biophysical Chemistry 2	2			2	Academic Credit
30	Chemical Engineering 1	2		2		Academic Credit
31	Chemical Engineering 2	2		2		Academic Credit
32	Biochemistry 1	1	1			
33	Biochemistry 2	1		1		
34	Analytical Chemistry	2	2			
35	Instrumental Analysis	2		2		
36	Intellectual Property	2			2	Academic Credit
37	Management in Engineering	1			1	
38	Practice in Applied Chemistry and Bioengineering 3	1	1			

Applied Chemistry Course

39	Experiments in Applied Chemistry 1	2		2		Required
40	Experiments in Applied Chemistry 2	2		2		Required
41	Functional Inorganic Chemistry	1			1	
42	Material Chemistry	1			1	
43	Chemical Engineering 3	2			2	
44	Chemical Engineering 4	2			2	

Biotechnology Course

45	Experiments in Biotechnology 1	2		2		Required
46	Experiments in Biotechnology 2	2		2		Required
47	Applied Microbiology	1			1	
48	Fermentation Technology	1			1	
49	Biocatalysis	2			2	Academic Credit
50	Molecular Biology	2			2	Academic Credit
	Total Credits of Specialized Subjects	83	20	34	29	
	Total Credits of Liberal Arts Subjects	46	20	14	12	
	Sum Total	129	40	48	41	

Curriculum 2023

General Education Subjects

	Subject	Credit	Credit per Student Year			Note
			3rd Grade	4th Grade	5th Grade	
51	Japanese 3	2	2			
52	Japanese 4	2		2		Academic Credit
53	History 2	2	2			
54	Politics and Economy	2		2		
55	Mathematics A-3-1	2	2			Specialized Basic Subject
56	Mathematics A-3-2	2	2			Specialized Basic Subject
57	Mathematics B-3	2	2			Specialized Basic Subject
58	Health and Physical Education 3	2	2			
59	Health and Physical Education 4	2		2		
60	Budo	1			1	Optional
61	English 3	1	1			Specialized Basic Subject
62	Technical English 1	2	2			
63	English Conversation 2	1	1			
64	Technical English 2	2		2		
65	Current English	2			2	
66	Elementary German	2		2		Select one subject
67	Elementary Chinese	2		2		
68	English Conversation 3	1			1	Optional
69	German Conversation	1			1	
70	Chinese Conversation	1			1	
71	Japanese	4	4			Foreign Students

	Subject	Credit	Credit per Student Year			Note
			3rd Grade	4th Grade	5th Grade	
72	Applied Ethics	2			2	Select one subject Academic Credit
73	Law	2			2	
74	Special Lecture on History	2			2	
75	International Understanding	2			2	
76	Natural Science History	2			2	
77	Special Lecture on Japanese	2			2	Select one subject Academic Credit
78	Practical English	2			2	
79	English for Reading amd Writing	2			2	
80	Intermediate German	2			2	
81	Intermediate Chinese	2			2	
82	Nature and Human Beings	2			2	Academic Credit
	Total Credits	56	16	12	28	
	Total Credits required to be taken	35	16	10	9	

Special Activity

	Subject		Credit Hour			Note
			3rd Grade	4th Grade	5th Grade	
83	Special Activity (3rd Grade)		30			Required

Overseas Language Training Subjects

	Subject	Credit	Term	Note
84	English Conversation Practice A1	1	Intensive	Optional
85	English Conversation Practice A2	1	Intensive	
86	English Conversation Practice B	2	Intensive	
87	Overseas Language Training A1	1	Intensive	Optional
88	Overseas Language Training A2	1	Intensive	
89	Overseas Language Training B	2	Intensive	

Special Course Curriculum

Special course for fostering next-generation plant engineers : PE course

	Subject	Credit	Term
90	Introduction to Plant Designing	1	4th Grade／1st Semester
91	Plant Maintenance	1	4th Grade／2nd Semester
92	Practice in Plant Engineering and Co-op1	1	4th Grade／Intensive
93	Practice in Plant Maintenance	1	5th Grade／1st Semester
94	Training course for Plant Supervisors	1	5th Grade／2nd Semester
95	Practice in Plant Engineering and Co-op2	1	5th Grade／Intensive

Special Course for Assistive Technology Engineer Development : AT course

	Subject	Credit	Term
96	Introduction to Assistive Technology	1	4th Grade／1st Semester
97	Practice in Assistive Design	1	4th Grade／2nd Semester
98	Practice in Clinical Equipments Development	1	5th Grade／1st Semester
99	Introduction to Medical Welfare Technology	1	5th Grade／2nd Semester
100	Practice in Assistive Technology and Co-op	2	5th Grade／Intensive

Special course for practical AI utilization engineer training : AI course

	Subject	Credit	Term
	Basic of "Monozukuri" and AI	1	1st～5th Grade／Intensive
	Application of "Monozukuri" and AI	1	1st～5th Grade／Intensive

101～106	Subject	Credit	Term
	Basic of "Monozukuri" and AI	2	1st～5th Grade／Intensive
	Application of "Monozukuri" and AI	2	1st～5th Grade／Intensive

Niihama College	Year	2023	Course Title	Experiments in Applied Chemistry and Bioengineering 1

Course Information

Course Code	140308	Course Category	Specialized / Compulsory
Class Format	Experiment	Credits	School Credits: 4
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	4
Textbook and/or Teaching Materials	生物応用化学実験1 テキスト　新居浜高専・生物応用化学科　編集		
Instructor			

Course Objectives

1. To understand the synthesis of zeolites, silica gel, colored glass, and fluorescent substances, as well as decolorization tests of dyes through photocatalysis and various electrical resistance measurements.
2. To synthesize inorganic compounds containing coordination compounds and to understand spectrochemical series.
3. To achieve proficiency in component analysis of inorganic compounds and component analysis in seawater.
4. To understand Faraday's law through copper electrolysis experiments and to achieve comprehension of the theoretical decomposition voltage and hydrogen/oxygen overvoltage in water electrolysis.
5. To compile and explain experimental methods, experimental results, and discussion in a report.
6. To propose original ideas and demonstrate the realization of those ideas under specified conditions in group experiments.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand and explain the phenomena involved in the synthesis of zeolites, silica gel, colored glass, and fluorescent substances, as well as decolorization tests of dyes through photocatalysis and various electrical resistance measurements.	Able to understand the phenomena involved in the synthesis of zeolites, silica gel, colored glass, and fluorescent substances, as well as decolorization tests of dyes through photocatalysis and various electrical resistance measurements.	Unable to understand the phenomena involved in the synthesis of zeolites, silica gel, colored glass, and fluorescent substances, as well as decolorization tests of dyes through photocatalysis and various electrical resistance measurements.
Achievement 2	Able to synthesize inorganic compounds containing coordination compounds, explain the meaning of each operation, and understand and explain the spectrochemical series.	Able to synthesize inorganic compounds containing coordination compounds and understand the spectrochemical series.	Unable to synthesize inorganic compounds containing coordination compounds or understand the spectrochemical series.
Achievement 3	Able to understand and explain Faraday's law through copper electrolysis experiments and the theoretical decomposition voltage and hydrogen/oxygen overvoltage in water electrolysis.	Able to understand Faraday's law through copper electrolysis experiments and the theoretical decomposition voltage and hydrogen/oxygen overvoltage through water electrolysis.	Unable to understand Faraday's law through copper electrolysis experiments and the theoretical decomposition voltage and hydrogen/oxygen overvoltage in water electrolysis.

Achievement 4	Able to understand and explain Faraday's law through copper electrolysis experiments and the theoretical decomposition voltage and hydrogen/oxygen overvoltage in water electrolysis.	Able to understand Faraday's law through copper electrolysis experiments and the theoretical decomposition voltage and hydrogen/oxygen overvoltage in water electrolysis.	Unable to understand Faraday's law through copper electrolysis experiments and the theoretical decomposition voltage and hydrogen/oxygen overvoltage in water electrolysis.
Achievement 5	Able to compile experimental methods, results and discussion in a report format and submit by the deadline. Able to explain the experimental results in their own words.	Able to compile experimental methods, results and discussion in a report format and submit by the deadline. Able to explain the experimental results through interaction with the teaching staff.	Unable to explain the experimental results even through interaction with the teaching staff.
Achievement 6	Able to propose their own ideas in group experiments and produce excellent work that conforms to the requirements.	Able to propose their own ideas in group experiments and produce work that conforms to the requirements.	Unable to propose their own ideas in group experiments or produce work that conforms to the requirements.

Assigned Department Objectives	
Specialized Knowledge (B), Problem-solving Ability (C)	
Teaching Method	
Outline	The goal is to acquire practical skills in basic experiments in inorganic chemistry and to gain knowledge in the field. Additionally, the objectives include learning the handling of instruments and equipment, report writing, safety procedures, and developing a mindset for experiments. In the latter half of the semester, a competitive group scientific experiment involving teams of four will be conducted to cultivate skills in project planning and problem-solving abilities.
Style	The class will progress through experiments and confirmatory tests. Together with the course Biological Applied Chemistry Experiment 2, group scientific experiments will be conducted. Recent and noteworthy topics incorporating both fundamental inorganic substance synthesis and analysis themes are also included. Theme coordinators will conduct oral examinations regarding the content of submitted reports. Unlike the first two years, students will be required to independently conduct the adjustment and operation of all reagents and chemicals, including strong acids and bases. Therefore, it is essential to exercise even greater caution with respect to safety. Safety goggles and lab coats must be worn at all times in the laboratory, and failure to comply may result in exclusion from the experiment.
Notice	As this course includes some content from the qualitative and quantitative analysis experiments in the first and second years, it is important for students to review them thoroughly. Students should study and pay attention to ensure that they are able to explain the concepts during report preparation. In the group scientific experiments, students will tackle the assigned tasks based on their individual ideas. Each group should devise a feasible plan, experimenting and refining it through trial and error to create the most excellent work.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	Guidance, group allocation	5
		2nd	Week 2 - Week 2–7: themes 1 through 8 (3 periods each).	5
		3rd	1. Synthesis of optical materials, photoresponsive/color-changing glass, and fluorescent substances, and observation of their coloration and fluorescence. Investigation of the decolorization of dyes using photocatalysts (titanium dioxide). Measurement of the electrical resistance of low-resistance films using the four-terminal method and the temperature characteristics of NTC and PTC using the two-terminal method.	1、5
		4th	2. Synthesis of Metal Complexes 1 (Copper(II) Complexes): Preparation of tetrachlorocopper(II) acid bis(diethylammonium), synthesis of cis and trans isomers of copper(II) glycinato hydrates, observation of the equilibrium of copper complexes. Measurement of the absorption spectra of cobalt complexes.	2、5
		5th	3. Analysis of Seawater, Ion Exchange Resin, and Ion Chromatography: Quantitative analysis of Ca^{2+}, Mg^{2+}, and Cl^- in seawater, cation removal experiment from seawater using a cation exchange resin, and analysis of anions in seawater using ion chromatography.	3, 5
		6th	4. Synthesis of Double Salts (Alum), Faraday's Law: Synthesis of copper(II) ammonium sulfate, potassium aluminum sulfate, and potassium chromium(III) sulfate. Electrolysis experiments with copper sulfate electrolyte.	1, 4, 5
		7th	5. Synthesis of Metal Complexes 2 (Polynuclear Metal Complexes), Silica Gel: Synthesis of sodium hexamolybdate and quantitative analysis of water. Synthesis of ammonium dodecamolybdate and observation of its redox behavior. Synthesis of silica gel and observation of its hygroscopic properties. Water electrolysis experiments.	2, 3, 4, 5
		8th	6. Synthesis of Metal Complexes 3 (Iron(III) Complexes), Crystal Growth: Synthesis of iron trioxalate complexes and quantitative analysis of Fe and C_2O_4. Additionally, observation of the crystal growth of four different inorganic salts under a microscope.	2, 3, 5

	2nd Quarter	9th	7. Synthesis of Sodium Carbonate, Chemical Batteries: Synthesis of sodium bicarbonate and production of sodium carbonate through its thermal decomposition. Assembly of a voltaic cell and a Daniell cell, and observation of their electricity generation characteristics.	2, 3, 4, 5
		10th	8. Zeolites, Solubility Measurement: Synthesis of zeolites and observation of their metal ion adsorption and gas component adsorption. Room-temperature solubility measurements for $H_2C_2O_4$ and MgC_2O_4 in pure water using quantitative analysis of C_2O_4.	1, 5
		11th	Weeks 27–30 <Group Experiments>. Lesson 1 Preparation (Distribution and confirmation of purchased parts).	6
		12th	Lessons 2–5 Assembly and experiment.	6
		13th	Lesson 6 Preparation of presentation (Confirmation of operation).	6
		14th	Lesson 7 Presentations (competitive).	6
		15th		
		16th		

Evaluation Method and Weight (%)

	Assignments	Quiz	Behavior	Group experiment	Total
Subtotal	50	20	10	20	100
Basic Proficiency	20	10	0	0	30
Specialized Proficiency	30	10	10	10	60
Cross Area Proficiency	0	0	0	10	10

Niihama College	Year	2023	Course Title	Experiments in Applied Chemistry and Bioengineering 2

Course Information

Course Code	140309	Course Category	Specialized / Compulsory
Class Format	Experiment	Credits	School Credit: 4
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	4
Textbook and/or Teaching Materials	生物応用化学実験2実験書　新居浜高専・生物応用化学科　編集、グループ科学実験の手引き　新居浜高専・生物応用化学科　編集、実験を安全に行うために　（化学同人）、続・実験を安全に行うために　（化学同人）		
Instructor			

Course Objectives

1. Acquire fundamental knowledge of safety in organic chemistry experiments and demonstrate the ability to handle reagents and experimental apparatus with care.
2. Assemble distillation, reflux, and stirring apparatus for organic chemistry experiments.
3. Prepare the necessary reagents for organic chemistry experiments and synthesize the desired organic compounds.
4. Compile experimental methods, results, and discussion into a report and be able to explain them.
5. In group scientific experiments, propose original ideas and demonstrate the realization of those ideas under the specified conditions.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the fundamentals of safety in organic chemistry experiments and handle reagents and experimental apparatus with care.	Able to acquire fundamental knowledge of safety in organic chemistry experiments and handle reagents and experimental apparatus with care.	Unable to acquire fundamental knowledge of safety in organic chemistry experiments or handle reagents and experimental apparatus with care.
Achievement 2	Able to assemble distillation, reflux, and stirring apparatus for organic chemistry experiments and explain the function of each component.	Able to assemble distillation, reflux, and stirring apparatus for organic chemistry experiments.	Unable to assemble distillation, reflux, and stirring apparatus for organic chemistry experiments
Achievement 3	Able to prepare the necessary reagents for organic chemistry experiments, synthesize the desired organic compounds, and elucidate the purpose of each operation.	Able to prepare the necessary reagents for organic chemistry experiments and synthesize the desired organic compounds	Unable to prepare the necessary reagents for organic chemistry experiments or synthesize the desired organic compounds
Achievement 4	Able to compile experimental methods, results and discussion in a report format and submit by the deadline. Able to explain the experimental results in their own words.	Able to compile experimental methods, results and discussion in a report format and submit by the deadline. Able to explain the experimental results through interaction with the teaching staff.	Unable to explain the experimental results even through interaction with the teaching staff.

Achievement 5	Able to propose their own ideas in group experiments and produce excellent work that conforms to the requirements.	Able to propose their own ideas in group experiments and produce work that conforms to the requirements.	Unable to propose their own ideas in group experiments or produce work that conforms to the requirements.

Assigned Department Objectives	
Specialized Knowledge (B)、Problem-solving Ability (C)	
Teaching Method	
Outline	This course aims to acquire practical skills in the synthesis and analysis of basic organic chemistry compounds through experiments. The goal is to gain not only technical expertise in experimental procedures but also to develop a deeper knowledge of organic chemistry. By using environmentally friendly substances, the course also seeks to raise awareness of environmental conservation, safety, and ethics for engineers. Expression skills and presentation abilities are further cultivated through report writing and presentations. In the latter half of the semester, students will engage in a competitive group scientific experiment, conducted in teams of four, to enhance project planning and problem-solving capabilities.
Style	Week 1: Guidance, Group allocation Weeks 2–26: <Organic Chemistry Experiment> Experiments and presentations on the following five themes (twice), along with theme-specific quizzes. 1. Synthesis of olefins from alcohols and their analysis by NMR 2. Collection of fragrances and synthesis of ethyl acetate 3. Synthesis of and dyeing with dyes, as well as microbial degradation of dyes 4. Synthesis of nitrobenzene and emulsion polymerization of vinyl acetate 5. Synthesis of plastic from milk and chemical/biochemical hydrolysis of biodegradable polymers Weeks 27–30: <Group Scientific Experiment>
Notice	Students should be well-versed in handling equipment and chemicals and should prioritize safety by wearing a lab coat and protective eyewear. Through hands-on experience, keen observation, and thoughtful consideration of phenomena, they should aim to master experimental techniques. Students will gain a deeper understanding of the organic chemistry learned in class and appreciate its fascination. Reports and presentations are emphasized by 'investigating, understanding thoroughly with your own mind, and summarizing clearly.' In group scientific experiments, students collaborate within the group to devise achievable plans based on individual ideas and strive to accomplish the given tasks through trial and error.

Characteristics of Class / Division in Learning

☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st	1st Quarter	1st	Guidance, group allocation	
		2nd	First round of experiments (1)	1, 2, 3
		3rd	First round of experiments（2）	1, 2, 3
		4th	First round of experiments（3）	1, 2, 3
		5th	Mini-test, guidance on reports	4
		6th	Second round of experiments（1）	1, 2, 3
		7th	Midterm test period	
		8th	Second round of experiments（2）	1, 2, 3

Semester	2nd Quarter	9th	Second round of experiments（3）	1, 2, 3
		10th	Mini-test, guidance on reports	4
		11th	Third round of experiments（1）	1, 2, 3
		12th	Third round of experiments（2）	1, 2, 3
		13th	Third round of experiments（3）	1, 2, 3
		14th	Mini-test, guidance on reports	4
		15th	End-of-term test period	
		16th	Presentation（1）	4
2nd Semester	3rd Quarter	1st	Fourth round of experiments（1）	1, 2, 3
		2nd	Fourth round of experiments（2）	1, 2, 3
		3rd	Fourth round of experiments（3）	1, 2, 3
		4th	Mini-test, guidance on reports	4
		5th	Fifth round of experiments（1）	1, 2, 3
		6th	Fifth round of experiments（2）	1, 2, 3
		7th	Midterm test period	
		8th	Fifth round of experiments（3）	1, 2, 3
	4th Quarter	9th	Mini-test, guidance on reports	4
		10th	Presentation（2）	4
		11th	Group Experiment (1)	5
		12th	Group Experiment（2）	5
		13th	Group Experiment（3）	5
		14th	Group Experiment（4）	5
		15th	End-of-term test period	
		16th	Group Experiment Presentations	4

Evaluation Method and Weight (%)

	Assignments	Quiz	Presentation	Performance report	Group Experiment	Behavior	Total
Subtotal	30	20	10	10	20	10	100
Basic Proficiency	0	0	0	0	0	0	30
Specialized Proficiency	30	20	0	10	0	10	60
Cross Area Proficiency	0	0	10	0	20	0	10

Niihama College	Year	2023	Course Title	Experiments in Applied Chemistry and Bioengineering 3

Course Information

Course Code	140419	Course Category	Specialized / Compulsory
Class Format	Experiment	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	『生物応用化学実験３テキスト』 新居浜高専・生物応用化学科編集　『物理化学実験法』後藤廉平 他著（共立出版）、『創造化学実験の取り組み方』新居浜高専・生物応用化学科編集		
Instructor			

Course Objectives

1. Understand the principles of measurement devices such as spectrophotometers, gas chromatographs, atomic absorption spectrophotometers, and conductivity meters, and be able to operate them correctly.
2. Acquire basic skills in physical chemistry experiments, including measurements of physical properties.
3. Consider experimental errors, reproducibility, reliability, and the treatment of significant figures.
4. Record and organize experimental data, plot the data on graphs, analyze the data based on theory, and determine the desired physical quantities.
5. Understand the methods of generating ideas and organizing them through Creative Chemistry Experiments.
6. In the Creative Chemistry Experiments, generate and organize ideas within a group under constraints, and identify and solve problems effectively.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the measurement principles of spectrophotometers, gas chromatographs, atomic absorption spectrophotomers, and conductivity meters and operate them correctly.	Able to grasp the measurement principles of spectrophotometers, gas chromatographs, atomic absorption spectrophotomers, and conductivity meters and operate them correctly.	Unable to grasp the measurement principles of spectrophotometers, gas chromatographs, atomic absorption spectrophotomers, and conductivity meters or operate them correctly.
Achievement 2	Able to perform basic operations of physical chemistry experiments, such as measurement of physical properties, with an understanding of what they mean.	Familiar with the basic operations of physical chemistry experiments, such as measurement of physical properties.	Not familiar with the basic operations of physical chemistry experiments, such as measurement of physical properties.
Achievement 3	Able to understand and handle the treatment of experimental errors, reproducibility, reliability, and significant figures.	Able to consider the treatment of experimental errors, reproducibility, reliability, and significant figures.	Unable to understand the treatment of experimental errors, reproducibility, reliability, and significant figures.
Achievement 4	Able to record and organize experimental data, plot the data on graphs, analyze the data based on theory, and determine the desired physical quantities. Able to explain the determined physical quantities in their own words.	Able to record and organize experimental data, plot the data on graphs, analyze the data based on theory, and determine the desired physical quantities.	Unable to analyze data based on theory from a plot of recorded and organized experimental data.

Achievement 5	Able to actively use methods to generate and organize ideas.	Able to understand methods to generate and organize ideas.	Unable to understand methods to generate and organize ideas.
Achievement 6	Able to assign roles in groups, generate and organize ideas under constraints, identify problems, and present a valid solution from a choice of multiple solutions to solve the problem.	Able to collaborate in a group to generate and organize ideas under constraints and to identify and solve problems.	Unable to collaborate in a group to generate and organize ideas under constraints and identify and solve problems.

Assigned Department Objectives	
Specialized Knowledge (B)、Problem-solving Ability (C)	
Teaching Method	
Outline	This course combines physical chemistry experiments, instrumental analysis experiments, and creative chemistry experiments. Physical Chemistry Experiments: Based on the topics covered in Physical Chemistry 1 and 2 and Biological Physical Chemistry 1, essential experiments related to fundamental laws have been selected as themes. The aim is to help students understand the physical significance of these laws. Instrumental Analysis Experiments: Focusing on the wide range of analytical instruments studied in the Instrumental Analysis course, experiments have been designed to cover their operational procedures and analytical principles. The objective is to facilitate an understanding of the methods used in instrumental analysis. Creative Chemistry Experiments: After learning the methods of generating and organizing ideas, students propose and plan competitive themes. Based on these themes, groups carry out experiments, leading to competitions and presentation sessions.
Style	In the Physical Chemistry Experiments and Instrumental Analysis Experiments, each group will consist of 2 or 3 members, and each theme will be conducted within one week. Reports will be submitted in the week following the completion of the experiment. In the Creative Chemistry Experiments, each group will consist of 4 members, with the group leader guiding the team to learn methods of idea generation and organization for problem-solving. The aim is to cultivate the ability to find ideas and solve problems as a group.
Notice	For the Physical Chemistry Experiments and Instrumental Analysis Experiments, it is essential to thoroughly read the textbook and reference materials before conducting the experiment. Understanding the experimental procedures and the purpose of each operation in advance is crucial. The purpose of the report is to communicate to others what was done during the experiments, not just to keep personal notes. Therefore, it is necessary to write the report in a way that is easy for the reader to understand. In oral examinations, the ability to explain what has been learned in one's own words is important. In the Creative Chemistry Experiments, it is crucial to collaborate as a group to generate and organize ideas to solve problems collectively.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Guidance on experiments and gas chromatography	1、4
		2nd	Electrical conductivity method	1、4
		3rd	Atomic absorption spectrometry	1、4
		4th	Visual spectrometry	1、4
		5th	Solubility and heat of dissolution of benzoic acid	2、3、4
		6th	Rate of decomposition reaction of hydrogen peroxide	2、3、4
		7th	Density of an aqueous ethanol solution	2、3、4
		8th	Freezing point depression of cyclohexane	2、3、4

	2nd Quarter	9th	Explanation of creative chemistry experiments Idea generation and organization of ideas	5
		10th	Devising and selecting themes	5、6
		11th	Devising and selecting themes	5、6
		12th	Devising and selecting themes	5、6
		13th	Group activities, production, and experiments	5、6
		14th	Group activities, production, and experiments	5、6
		15th		
		16th		
2nd Semester	3rd Quarter	1st	Group activities, production, and experiments	5、6
		2nd	Group activities, production, and experiments	5、6
		3rd	Group activities, production, and experiments	5、6
		4th	Group activities, production, and experiments	
		5th	Presentation	
		6th	Presentation	
		7th		
		8th		
	4th Quarter	9th		
		10th		
		11th		
		12th		
		13th		
		14th		
		15th		
		16th		

Evaluation Method and Weight (%)

	Experimental results and report	Creative experiment	Mutual Evaluations between students	Behavior	Portforio	Other	Total
Subtotal	50	40	0	10	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	50	20	0	10	0	0	80
Cross Area Proficiency	0	20	0	0	0	0	20

Niihama College	Year	2023	Course Title	Experiments in Applied Chemistry and Bioengineering 4

Course Information

Course Code	140420	Course Category	Specialized / Compulsory
Class Format	Experiment	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	生物応用化学実験4テキスト　新居浜高専・生物応用化学科　編集／創造化学実験の取り組み方　新居浜高専・生物応用化学科　編集／バイオ実験を安全に行うために　化学同人編集部 編　（化学同人）		
Instructor			

Course Objectives

1. Through experiments in areas such as fluid dynamics, heat transfer, mass transfer, and powder handling, acquire proficiency in the fundamental operations of chemical engineering experiments and develop the ability to visualize each phenomenon.
2. Handle enzymes and microorganisms through experiments such as enzyme activity measurement, medium preparation, and microbial inoculation.
3. Record and organize experimental data, plot the data on graphs, analyze the data based on theory, and determine the desired physical quantities.
4. Understand the methods of generating ideas and organizing them through the Creative Chemistry Experiments.
5. In the Creative Chemistry Experiments, generate and organize ideas under constraints, and identify and solve problems.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to become skilled in the fundamental operations of chemical engineering experiments through work in areas such as fluid dynamics, heat transfer, and mass transfer, and to elucidate each phenomenon.	Able to acquire knowledge of the fundamental operations of chemical engineering experiments through work in areas such as fluid dynamics, heat transfer, and mass transfer, and to visualize each phenomenon.	Unable to acquire knowledge of the fundamental operations of chemical engineering experiments in areas such as fluid dynamics, heat transfer, and mass transfer, or to visualize each phenomenon
Achievement 2	Able to handle enzymes and microorganisms through experiments such as enzyme activity measurement, medium preparation, and microbial inoculation, with a comprehension of their significance.	Able to handle enzymes and microorganisms through experiments such as enzyme activity measurement, medium preparation, and microbial inoculation.	Unable to handle enzymes and microorganisms in experiments such as enzyme activity measurement, medium preparation, and microbial inoculation.

Achievement 3	Able to record and organize experimental data, present it graphically, analyze the data based on theory, and ascertain the desired physical quantities. Additionally, capable of articulating the determined physical quantities in their own words.	Able to record and organize experimental data, present it graphically, analyze the data based on theory, and ascertain the desired physical quantities.	Unable to analyze data based on theory from a graph of recorded and organized experimental data.
Achievement 4	Able to actively use methods to generate and organize ideas.	Able to understand methods to generate and organize ideas.	Unable to understand methods to generate and organize ideas.
Achievement 5	Able to generate and organize ideas, identify problems, and present a valid solution from a choice of multiple solutions to solve the problem.	Able to generate and organize ideas, identify problems, and solve them.	Unable to generate and organize ideas or identify problems and solve them.

Assigned Department Objectives	
Specialized Knowledge (B)、Problem-solving Ability (C)	
Teaching Method	
Outline	This course combines Chemical Engineering, Biotechnology, and Creative Science Experiments. Chemical Engineering and Biotechnology Experiments: The goal is to master the operation of industrial equipment and basic operations in biotechnology, as well as learn how to organize experimental data. Creative Chemistry Experiments: After learning methods for generating and organizing ideas, the students will devise experiments in chemistry and physics, engaging in activities that involve discovering and solving problems during this process.
Style	Chemical engineering and biotechnology experiments will be conducted by dividing the class into two groups, alternating with "Experiments in Applied Chemistry and Bioengineering 3." Creative chemistry experiments will be conducted with all class members involved.
Notice	The chemical engineering experiments include fundamental operations in chemical engineering such as fluid dynamics, heat transfer, and mass transfer. Students should strive to understand each transfer phenomenon and master data organization methods. The biotechnology experiment serves as a compact course on the basics (proliferation and counting) and applications (fermentation production) of microorganisms, focusing on the basic techniques of handling microorganisms and fostering thinking skills. Students should be conscious of the experimental skills in each experiment. A single missing report will result in the non-granting of credits. In the creative chemistry experiment, students will learn how to generate and organize ideas as one of the ways to generate ideas for problem-solving. By using this method to generate and organize numerous ideas, they will develop the ability to find solutions to problems. Students should prepare well by previewing the experimental text before conducting the experiment.

Characteristics of Class / Division in Learning			
☑ Active Learning	□ Aided by ICT	□ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	<Chemical Engineering and Biotechnology Experiments (Weeks 1–8 of the First Semester)> Guidance, experiments 1–6 in rotations by groups.	1, 3
		2nd	1. Flow Rate Measurement: Creating a calibration curve for an orifice meter and understanding the principles of flow rate measurement.	1, 3
		3rd	2. Non-State Heat Conduction: Measurement of thermal conductivity in a solid through one-dimensional non-state heat conduction.	1, 3
		4th	3. Fractional Distillation: Fractional distillation of a methanol–water system to become proficient in material balance calculations.	1, 3
		5th	4. Evaporation of Water in a Wetted Wall Column: Measurement of the relationship between the Reynolds number and gas film mass transfer coefficient in the operation of water evaporation.	1, 3
		6th	5. Measurement of Microbial Count (1): Physical determination of the total microbial count using yeast cells and measurement of the biological viable count.	2, 3
		7th	5.微生物数の計測（２） :酵母菌を用いた物理学的総菌数測定および生物学的生菌数の測定法	2, 3
		8th	6. Bacterial Examination and Enzyme Activity Measurement (1): Coliform test using the plate culture method, and fermentation production and activity measurement of amylase using *Aspergillus oryzae* .	2, 3
	2nd Quarter	9th	6. Bacterial Examination and Enzyme Activity Measurement (2): Coliform test using the plate culture method, and fermentation production and activity measurement of amylase using *Aspergillus oryzae* . <Creative Chemistry Experiment> Guidance on idea generation and organization.	4, 5
		10th	<Creative Chemistry Experiment> Guidance on idea generation and organization.	4, 5
		11th	Team allocation, devising, and selecting themes.	4, 5
		12th	Devising and selecting themes.	4, 5
		13th	テーマの考案と選出	4, 5
		14th	テーマの考案と選出	4, 5
		15th	Group activities, production, and experiments.	4, 5
		16th		

2nd Semester	3rd Quarter	1st	グループ活動、製作、実験	4, 5
		2nd	グループ活動、製作、実験	4, 5
		3rd	グループ活動、製作、実験	4, 5
		4th	Presentation	4, 5
		5th	Presentation	4, 5
		6th	<Chemical Engineering and Biotechnology Experiments (Weeks 6–14 of the Second Semester)> Same as the first semester.	1, 3
		7th		
		8th		
	4th Quarter	9th		
		10th		
		11th		
		12th		
		13th		
		14th		
		15th		
		16th		

Evaluation Method and Weight (%)

	Experimental results including technical proficiency level	Report including oral examination	Behavior	Creative experiments	Total
Subtotal	20	30	10	40	100
Basic Proficiency	0	0	0	0	0
Specialized Proficiency	20	30	10	40	100
Cross Area Proficiency	0	0	0	0	0

Niihama College	Year	2023	Course Title	Presentation Skills

Course Information

Course Code	140420	Course Category	Specialized / Compulsory
Class Format	Seminar	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	プレゼンテーション技法配布プリント　衣笠・西井作成		
Instructor			

Course Objectives

1. Learn to research a specific topic and organize findings as a presentation with a clear goal and a logical structure.
2. Learn to use presentation software to create slides with easily visible text and diagrams and an emphasis on important sections.
3. Learn to present to an audience using appropriate speech speed and volume, as opposed to merely reading the text.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can research a specific topic and organize findings as a presentation with a clear goal and a logical structure	Can research a specific topic and organize findings as a presentation with a clear goal	Cannot research a specific topic or organize findings as a presentation with a clear goal
Achievement 2	Can use presentation software to create slides with easily visible text and diagrams and an emphasis on important sections	Can use presentation software to create slides with easily visible text and diagrams	Cannot use presentation software to create slides with easily visible text and diagrams
Achievement 3	Can present to an audience using appropriate speech speed and volume, as opposed to merely reading the text	Can present to an audience using an appropriate speech speed and volume, as opposed to merely reading the text	Cannot present to an audience using an appropriate speech speed and volume, as opposed to merely reading the text

Assigned Department Objectives

Fundamental Scientific Knowledge (A), Communication Skill (E)

Teaching Method

Outline	Practice how to present on a specific topic by researching a subject, such as in books, and summarizing and presenting the research findings.
Style	Lectures and presentations will be given. Lectures will teach presentation skills and incorporate practical exercises. Each class will be given assignments.
Notice	The goal of this class is for students to learn how to communicate information to others. Therefore, students must learn how to pay attention to presentation structure, speaking techniques, slide preparation, etc. Presentations must go beyond listing one's research and knowledge, and presenters should devise ways to grab the audience's interest. The lectures will cover these basic skills, and students are expected to prepare their presentations based on the lecture contents. Investing effort in preparation is the key to improvement. In addition to classes on presentations as part of the Information Literacy and Computer Science courses, students should take this course to gain experience in creating and delivering presentations on each subject. Students will certainly make use of the skills learned here in various places, such as internship debriefing sessions, graduation research presentations, and corporate presentations after graduation.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	Overview on presentations, identifying goals and key messages, collecting and organizing information	
		2nd	Basic logic skills	
		3rd	Structure Skills 1 (Main argument, logical presentation)	
		4th	Structure Skills 2 (Introduction, conclusion)	
		5th	Basic expression skills, speaking skills	
		6th	Slide Preparation Skills 1 (Font size, bullet points)	
		7th	Mid-term exams	
		8th	Slide Preparation Skills 2 (Basics of color schemes, diagrams)	
	2nd Quarter	9th	Slide Preparation Skills 3 (Tables and graphs)	
		10th	Practical Skills for Presenting Science and Technology 1	
		11th	科学技術紹介プレゼンテーション実技2	
		12th	科学技術紹介プレゼンテーション実技3	
		13th	科学技術紹介プレゼンテーション実技4	
		14th	Slide Preparation Skills 4 (Integration with Word and Excel)	
		15th	End-of-term exams	
		16th		

Evaluation Method and Weight (%)

	Presentation	Submission	Total
Subtotal	80	20	100
Basic Proficiency	0	0	0
Specialized Proficiency	0	0	0
Cross Area Proficiency	80	20	100

Niihama College	Year	2023	Course Title	Internship A

Course Information			
Course Code	140417	Course Category	Specialized / Compulsory
Class Format	Practical training	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Intensive	Classes per Week	
Textbook and/or Teaching Materials			
Instructor			

Course Objectives

1. Experience the real world application of the knowledge and experimental techniques learned.
2. Realize the importance of manners as a member of an organization, the importance of a sense of responsibility as an individual, and the importance of ethics as an engineer.
3. Learn to present on practical training contents and social experiences

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Understands and can explain how the knowledge and experimental techniques learned can be applied in the real world	Understands that the knowledge and experimental techniques learned can be applied in the real world	Does not understand that the knowledge and experimental techniques learned are applicable in the real world
Achievement 2	Understands and can explain the importance of manners as a member of an organization, the importance of a sense of responsibility as an individual, and the importance of ethics as an engineer	Understands the importance of manners as a member of an organization, the importance of a sense of responsibility as an individual, and the importance of ethics as an engineer.	Does not understand the importance of manners as a member of an organization, the importance of a sense of responsibility as an individual, and the importance of ethics as an engineer.
Achievement 3	Can present on practical training content and social experiences and correctly answer questions	Can present on practical training contents and social experiences	Cannot present on practical training content and social experiences

Assigned Department Objectives

Culture (D), Communication Skill (E), Sociability (F)

Teaching Method

Outline	Through off-campus practical training, students will learn the importance of manners as a member of an organization and will also develop a sense of personal responsibility. Additionally, they will gain an understanding of the importance of ethics as engineers in the real world.
Style	1. Before practical training, students will attend pre-training lectures and submit a pre-study learning book. 2. During summer vacation, students will participate in about 10 days of off-campus practical training. 3. Students will attend practical training off-campus at factories, public offices, commercial laboratories, university laboratories, and other relevant sites. 4. After completing practical training, students will obtain a certificate from the supervisor at the host organization and prepare a report. 5. Teachers will hold a training debriefing session for third-year students.

Notice	Students are expected to follow the instructions of the organization where they are interning and act sensibly. Pay attention to the differences between the knowledge learned at school and the situation on the ground broadly and from various perspectives. Students should use this experience as a springboard for future studies. Students should select their internship location based on their lower-grade off-campus training, and third and fourth years should consider their factory tours and career aspirations. Depending on the content of the internship, students may have to study in advance to utilize the knowledge gained in lectures and experimental practice in the lower grades. (Clarify purpose.) Knowledge gained in internships will be useful for experiments and graduation study in the fourth year, as well as in determining career paths.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Before practical training, students will attend pre-training lectures and submit a pre-study learning book.	1
		2nd	During summer vacation, students will participate in about 10 days of off-campus practical training.	1, 2
		3rd	In addition to analytical chemistry-related work, students will be exposed to work at production sites and research work conducted in laboratories.	1, 2
		4th	After completing the internship, students will submit an internship report and an achievement confirmation sheet.	3
		5th	Teachers will hold a training briefing session for third-year students.	3
		6th		
		7th		
		8th		
	2nd Quarter	9th		
		10th		
		11th		
		12th		
		13th		
		14th		
		15th		
		16th		

Evaluation Method and Weight (%)

	Achievement Confirmation Sheet	Presentation	Peer Assessment	Behavior	Portfolio	Other	Total
Subtotal	50	50	0	0	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	25	0	0	0	0	0	25
Cross Area Proficiency	25	50	0	0	0	0	75

Niihama College	Year	2023	Course Title	Internship B

Course Information			
Course Code	140418	Course Category	Specialized / Compulsory
Class Format	Practical training	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Intensive	Classes per Week	
Textbook and/or Teaching Materials			
Instructor			

Course Objectives

1. Experience the real world application of the knowledge and experimental techniques learned.
2. Realize the importance of manners as a member of an organization, the importance of a sense of responsibility as an individual, and the importance of ethics as an engineer.
3. Learn to present on practical training contents and social experiences

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Understands and can explain how the knowledge and experimental techniques learned can be applied in the real world	Understands that the knowledge and experimental techniques learned can be applied in the real world	Does not understand that the knowledge and experimental techniques learned are applicable in the real world
Achievement 2	Understands and can explain the importance of manners as a member of an organization, the importance of a sense of responsibility as an individual, and the importance of ethics as an engineer	Understands the importance of manners as a member of an organization, the importance of a sense of responsibility as an individual, and the importance of ethics as an engineer.	Does not understand the importance of manners as a member of an organization, the importance of a sense of responsibility as an individual, and the importance of ethics as an engineer.
Achievement 3	Can present on practical training content and social experiences and correctly answer questions	Can present on practical training contents and social experiences	Cannot present on practical training content and social experiences

Assigned Department Objectives

Culture (D)、Communication Skill (E) 、Sociability (F)

Teaching Method

Outline	Through off-campus practical training, students will learn the importance of manners as a member of an organization and will also develop a sense of personal responsibility. Additionally, they will gain an understanding of the importance of ethics as engineers in the real world.
Style	1. Before practical training, students will attend pre-training lectures and submit a pre-study learning book. 2. During summer vacation, students will participate in about 10 days of off-campus practical training. 3. Students will attend practical training off-campus at factories, public offices, commercial laboratories, university laboratories, and other relevant sites. 4. After completing practical training, students will obtain a certificate from the supervisor at the host organization and prepare a report. 5. Teachers will hold a training debriefing session for third-year students.

Notice	Students are expected to follow the instructions of the organization where they are interning and act sensibly. Pay attention to the differences between the knowledge learned at school and the situation on the ground broadly and from various perspectives. Students should use this experience as a springboard for future studies. Students should select their internship location based on their lower-grade off-campus training, and third and fourth years should consider their factory tours and career aspirations. Depending on the content of the internship, students may have to study in advance to utilize the knowledge gained in lectures and experimental practice in the lower grades. (Clarify purpose.) Knowledge gained in internships will be useful for experiments and graduation study in the fourth year, as well as in determining career paths.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Before practical training, students will attend pre-training lectures and submit a pre-study learning book.	1
		2nd	During summer vacation, students will participate in about 10 days of off-campus practical training.	1, 2
		3rd	In addition to analytical chemistry-related work, students will be exposed to work at production sites and research work conducted in laboratories.	1, 2
		4th	After completing the internship, students will submit an internship report and an achievement confirmation sheet.	3
		5th	Teachers will hold a training briefing session for third-year students.	3
		6th		
		7th		
		8th		
	2nd Quarter	9th		
		10th		
		11th		
		12th		
		13th		
		14th		
		15th		
		16th		
2nd Semester	3rd Quarter	1st		
		2nd		
		3rd		
		4th		
		5th		
		6th		
		7th		
		8th		
		9th		
		10th		
		11th		

	4th Quarter	12th		
		13th		
		14th		
		15th		
		16th		

Evaluation Method and Weight (%)

	Achievement Confirmation Sheet	Presentation	Peer Assessment	Behavior	Portfolio	Other	Total
Subtotal	50	50	0	0	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	25	0	0	0	0	0	25
Cross Area Proficiency	25	50	0	0	0	0	75

Niihama College	Year	2023	Course Title	Graduation Study

Course Information			
Course Code	140517	Course Category	Specialized / Compulsory
Class Format	Practical training	Credits	School Credit: 8
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Year-round	Classes per Week	8
Textbook and/or Teaching Materials			
Instructor			

Course Objectives

1. Gain an understanding of the research objectives in relation to the social background and previous research.
2. Learn to conduct experiments in accordance with the reseach objectives, observe and record results, and organize them in a lab notebook.
3. Learn to correctly interpret the obtained experimental data.
4. Learn to summarize experimental results and describe them logically in writing.
5. Learn to orally present experimental results and appropriately respond to queries in discussions.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Understands the research objectives in relation to the social context and previous research	Understands the research objectives in relation to the social context	Does not understand the research objectives in relation to the social context
Achievement 2	Can conduct experiments in accordance with the research objectives, observe and record results, and organize them in research notes, including the researcher's own reflections	Can conduct experiments in accordance with the research objectives, observe and record results, and organize them in research notes	Cannot observe and record experimental results and organize them in research notes
Achievement 3	Correctly interprets the obtained experimental data and explains findings logically	Can correctly interpret the obtained experimental data	Cannot correctly interpret the obtained experimental data
Achievement 4	Can summarize experimental results and logically describe research content in writing supplemented by diagrams and tables	Can summarize experimental results and describe research content in writing supplemented by diagrams and tables	Cannot summarize experimental results or describe research content in writing supplemented by diagrams and tables
Achievement 5	Can orally present experimental results and respond to queries appropriately in discussions	Can orally present experimental results and respond to queries in discussions	Cannot orally present experimental results or respond to queries in discussions

Assigned Department Objectives

Problem-solving Ability (C), Communication Skill (E)

Teaching Method	
Outline	Students will conduct individual research on a relevant topic to learn how to use specialized knowledge and experimental skills to systematically solve problems. Students will also learn basic presentation skills by preparing papers and presentations.
Style	Each student will have their own research topic and will conduct research under the guidance of a faculty member. The main topics are as follows: development of new functional ceramics, biodegradation of environmental pollutants, protein separation using surfactants, processing of colored wastewater by solvent extraction, interaction of macromolecules and surfactants, synthesis and application of photo-functional molecules, synthesis and practical application of biodegradable macromolecules, extraction and separation of proteins using inverse micelles, development of drug diffusion devices, elucidation and application of mechanisms of environmentally responsive macromolecular solutions, production of useful substances from unused refractory biomass, design and application of environmentally responsive molecules, functional evaluation of food components using animal cells, and others. An interim presentation will be required at the end of the first semester. At the end of the academic year, a graduation research paper will be submitted and a research presentation will be required.
Notice	Unlike the student experiments conducted up to the second year, graduation research involves original research that no other researcher has undertaken. Depending on the experimental results, it may lead to new discoveries that might overturn conventional wisdom. Each student is expected to actively engage in research and pioneer in new fields. Students are also expected to acquire the ability to read papers and books to learn about basic matters related to their research topic, as well as the ability to prepare a graduate research paper and presentation with reference to presentations in the department.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Guidance on and selection of research topics in each laboratory	
		2nd	Understanding research objectives, literature review	
		3rd	Understanding research objectives, literature review	
		4th	Understanding research objectives, literature review	
		5th	Understanding research objectives, literature review	
		6th	Understanding research objectives, literature review	
		7th	Mid-term exams	
		8th	Understanding research objectives, literature review	
		9th	Understanding research objectives, literature review	
		10th	Understanding research objectives, literature review	

	2nd Quarter	11th	Understanding research objectives, literature review	
		12th	Understanding research objectives, literature review	
		13th	Conducting experiments, organizing data, conducting analysis, and engaging in discussion	
		14th	Conducting experiments, organizing data, conducting analysis, and engaging in discussion	
		15th	End-of-term exams	
		16th	Conducting experiments, organizing data, conducting analysis, and engaging in discussion	
2nd Semester	3rd Quarter	1st	Formulation and refinement of research methods and plans	
		2nd	Conducting experiments, organizing data, conducting analysis, and engaging in discussion	
		3rd	Conducting experiments, organizing data, conducting analysis, and engaging in discussion	
		4th	Conducting experiments, organizing data, conducting analysis, and engaging in discussion	
		5th	Conducting experiments, organizing data, conducting analysis, and engaging in discussion	
		6th	Conducting experiments, organizing data, conducting analysis, and engaging in discussion	
		7th	Mid-term exams	
		8th	Conducting experiments, organizing data, conducting analysis, and engaging in discussion	
	4th Quarter	9th	Conducting experiments, organizing data, conducting analysis, and engaging in discussion	
		10th	Conducting experiments, organizing data, conducting analysis, and engaging in discussion	
		11th	Conducting experiments, organizing data, conducting analysis, and engaging in discussion	
		12th	Preparing graduation thesis	
		13th	Preparing graduation thesis	
		14th	Preparing research presentation	
		15th	End-of-term exams	
		16th	Graduation research presentation	

Evaluation Method and Weight (%)							
	Understanding of contents	Laboratory Techniques	Problem Solving	Behavior	Presentation	Thesis	Total
Subtotal	20	20	10	10	20	20	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	20	20	0	0	0	0	40
Cross Area Proficiency	0	0	10	10	20	20	60

Niihama College	Year	2023	Course Title	Engineering Ethics

Course Information			
Course Code	140516	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	はじめての工学倫理 第３版 斎藤了文、坂下浩司編（昭和堂）/第二版 大学講義技術者の倫理入門 杉本泰治、高城重厚著（丸善）、実践的工学倫理 中村収三著（化学同人）、技術者倫理の世界 藤本温編（森北出版）、技術者倫理入門 谷垣昌敬 監修、吉村忠与志、戸島貴代志著（オーム社）、はじめての工学倫理 初版 斎藤了文、坂下浩司編（昭和堂）		
Instructor			

Course Objectives

1. Able to define the scope and magnitude of the impact of the results of technological solutions on society and nature
2. Able to use the seven-step guide method when making decisions as an engineer
3. Able to define the basics of risk management
4. Able to take decisions based on the code of ethics as an engineer
5. Able to understand the basic concept of an engineer's responsibility for products
6. Able to define the role an engineer in an organization
7. Able to explain the necessity of intellectual property rights (especially patent rights and copyrights) as an engineer

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the scope and magnitude of the impact of the results of technological solutions on society and nature, and consider applying them to one's own engineering field	Able to explain the scope and magnitude of the impact of the results of technological solutions on society and nature in general terms	Unable to explain the scope and magnitude of the impact of the results of technological solutions on society and nature in general terms
Achievement 2	Able to use the seven-step guide method when making decisions as an engineer	Able to explain the seven-step guide method used when making decisions as an engineer	Unable to explain the seven-step guide method used when making decisions as an engineer
Achievement 3	Able to explain the basics of risk management, and consider applying them to one's own engineering field	Able to explain the basics of risk management	Unable to explain the basics of risk management
Achievement 4	Able to judge based on the code of ethics as an engineer	Able to explain the necessary code of ethics as an engineer	Unable to explain the necessary code of ethics as an engineer
Achievement 5	Able to explain the basic concepts of engineer's responsibility for products, and consider applying them to one's own engineering field	Able to explain the basic concepts of engineer's responsibility for products	Unable to explain the basic concepts of engineer's responsibility for products
Achievement 6	Able to define the role of an engineer in an organization, and choose the appropriate idea among them	Able to define the role of an engineer in an organization	Unable to define the role of an engineer in an organization

Achievement 7	Able to explain the necessity of intellectual property rights (especially patent rights and copyrights) as an engineer, and consider applying them to one's own engineering field	Able to explain the necessity of intellectual property rights (especially patent rights and copyrights) as an engineer	Unable to explain the necessity of intellectual property rights (especially patent rights and copyrights) as an engineer

Assigned Department Objectives	
Culture (D)	
Teaching Method	
Outline	With the progress of science and technology, the impact of the judgment of engineers on society and the environment should be understood along with the fact that engineers must propose and implement solutions. Moreover, the values (judgment) in identifying solutions should be known.
Style	Classes will be conducted with explanations and discussions while introducing various examples, focusing on textbooks. Assignments will be provided every time.
Notice	Understanding that such ethical aspects are followed in the decision-making of engineers, recognizing the necessity of having a broad perspective and independent thinking, and making judgments based on information from various areas for self-study (report preparation). This course is an academic credit course and requires self-study of at least (45 hours－lecture hours). Therefore, of the assignments assigned by the faculty in charge of the course, credits will not be granted unless assignments equivalent to {(45 hours－lecture hours) x 3/4} hours or more are submitted.

Characteristics of Class / Division in Learning			
□ Active Learning	□ Aided by ICT	□ Applicable to Remote Class	□ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Introduction (Why Ethics for Engineers?)	1
		2nd	Ethical concepts of engineering (methods for solving ethical problems)	2
		3rd	Applied ethics (environmental ethics and engineering ethics)	1
		4th	Risk management	3
		5th	Sexual harassment	4
		6th	Safety and design	4, 5
		7th	Trade secrets	6
		8th	Code of Ethics	4
	4th Quarter	9th	Process management	3, 4, 6
		10th	Intellectual property rights	7
		11th	Responsibilities as a Profession (Engineer)	1, 2, 3, 4, 5, 6, 7
		12th	Product liability law	5
		13th	Corporate Social Responsibility	1
		14th	Conflict between engineers and organizations	4, 6
		15th	Pros and cons of whistleblowing	1, 4, 6
		16th		

Evaluation Method and Weight (%)

	Assignments	Total
Subtotal	100	100
Basic Proficiency	0	0
Specialized Proficiency	0	0
Cross Area Proficiency	100	100

Niihama College	Year	2023	Course Title	Engineering English

Course Information			
Course Code	140508	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	Chemistry Laboratory for Secondary and Higher Education　園部利彦・川泉文男　著　（学術図書）		
Instructor			

Course Objectives

1. Master commonly used chemical and technical English vocabulary.
2. Master expressions related to experimental manipulations commonly used in scientific and technical literature.
3. Learn to read and comprehend chemical laboratory texts and equipment manuals written in English.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Understands the meanings of and can correctly spell specialized chemical and technical English terms	Understands the meanings of and can correctly spell commonly required chemical and technical English terms	Does not understand the meanings of and cannot correctly spell commonly required chemical and technical English terms
Achievement 2	Can translate into Japanese and use expressions related to experimental manipulations that are common in scientific and technical literature	Can translate into Japanese expressions related to experimental manipulations that are commonly used in scientific and technical literature	Cannot translate into Japanese expressions related to experimental manipulations that are commonly used in scientific and technical literature
Achievement 3	Can read and understand abstracts in technical journals	Can read and comprehend chemical laboratory texts and equipment manuals written in English	Cannot read chemical laboratory texts and equipment manuals written in English

Assigned Department Objectives

Communication Skill (E)

Teaching Method

Outline	The objectives of this course are for students to read and comprehend reading materials with scientific content as well as scientific and technical papers and master scientific English expressions and specialized terminology in various fields.
Style	In the first semester, students will read secondary education-level experimental texts that originated in countries with English as a second language and review their understanding based on the results of a common test. The test will also include English vocabulary related to chemical technologies selected by faculty in the Department of Applied Chemistry and Biotechnology. In the second semester, students will read specialized books and journals in their respective laboratories to strengthen their English language skills. Students will also study and improve their vocabulary skills using a list of 100 English words related to chemical technologies selected by faculty in the Department of Applied Chemistry and Biotechnology.

Notice	Our society is becoming increasingly internationalized, and engineers are expected to need English language skills more than ever to conduct their work. This course aims to help students develop the minimum necessary technical literature reading comprehension. The first semester covers a secondary education-level English-language chemistry laboratory experiments book, and students who possess knowledge of basic chemistry experiments should be able to read the content easily and purposefully.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Guidance	
		2nd	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
		3rd	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
		4th	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
		5th	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
		6th	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
		7th	Mid-term exams	
		8th	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
	2nd Quarter	9th	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
		10th	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
		11th	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
		12th	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
		13th	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
		14th	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
		15th	Reading comprehension of common texts, English reading by each teacher	1, 2, 3
		16th	End-of-term exams	
2nd	3rd Quarter	1st	Common tests	
		2nd	Teacher-led English reading exercise	1, 2, 3
		3rd	Teacher-led English reading exercise	1, 2, 3
		4th	Teacher-led English reading exercise	1, 2, 3
		5th	Teacher-led English reading exercise	1, 2, 3
		6th	Teacher-led English reading exercise	1, 2, 3
		7th	Mid-term exams	
		8th	Teacher-led English reading exercise	1, 2, 3

Semester	4th Quarter	9th	Teacher-led English reading exercise	1, 2, 3
		10th	Teacher-led English reading exercise	1, 2, 3
		11th	Teacher-led English reading exercise	1, 2, 3
		12th	Teacher-led English reading exercise	1, 2, 3
		13th	Teacher-led English reading exercise	1, 2, 3
		14th	Teacher-led English reading exercise	1, 2, 3
		15th	Teacher-led English reading exercise	1, 2, 3
		16th	End-of-term exams	

Evaluation Method and Weight (%)

	Common Test	Reading Comprehension	Total
Subtotal	30	70	100
Basic Proficiency	15	30	45
Specialized Proficiency	15	40	55
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Applied Mathematics C

Course Information			
Course Code	140401	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	新応用数学　佐藤志保 著　大日本図書、新応用数学問題集　嶋野和史 著　大日本図書		
Instructor			

Course Objectives

1. Calculating and applying the vectors' inner and outer products
2. Understanding the spatial curves and curved surfaces to derive the curve length and the curved surface area
3. Deriving the gradient, divergence, and rotation
4. Understanding the regular and complex functions to derive the complete and partial differentiation
5. Calculating the complex integrals and applying Cauchy's integral theorem

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Understanding and applying vectors' inner and outer products	Obtaining vectors' inner and outer products	Unable to obtain the vectors' inner and outer products
Achievement 2	Deriving the curve length and the curved surface area of various spatial curves and curved surfaces	Deriving the curve length and the curved surface area of basic spatial curves and curved surfaces	Unable to derive the curve length and the curve surface
Achievement 3	Understanding the physical meaning and applying gradient, divergence, and rotation	Derving gradient, divergence, and rotation	Unable to derive gradient, divergence, and rotation
Achievement 4	Understanding and applying regular and complex functions	Understanding regular and complex functions to calculate complete and partial differentiation	Unable to understand the regular and complex functions to calculate complete and partial differentiation
Achievement 5	Applying Cauchy's integral theorem and calculating complex integrals	Applying Cauchy's integral theorem and basic calculations of complex integrals	Unable to apply Cauchy's integral theorem and perform basic calculations of complex integrals

Assigned Department Objectives

Fundamental Scientific Knowledge (A)

Teaching Method

Outline	Learn the vector and complex analysis basics. These are the fundamental aspects of engineering.

Style	First semester involves using vector analyses to learn curves, surfaces, gradients, divergence, rotation, etc. Second semester involves using complex analysis to learn regular functions, complex integrals, and Cauchy's integral theorem. The lectures will focus on the textbook content. Practice as many problem exercises as possible and make the classes more entrenched.
Notice	This is a compulsory elective course. It is related to the promotion to grade 5 and graduation. Please check the curriculum guidelines carefully.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Vectors of space	1
		2nd	Inner product of vectors	1
		3rd	Outer product of vectors	1
		4th	Vector functions	1
		5th	Curves	2
		6th	Curved surfaces	2
		7th	Midterm examinations	
		8th	Examination results, Gradient	3
	2nd Quarter	9th	Divergence	3
		10th	Rotation	3
		11th	Rotation	3
		12th	Application of rotation and divergence	3
		13th	Line integral of scalar field	3
		14th	Line integral of vector field	3
		15th	Final examinations	3
		16th	Examination Results	
2nd Semester	3rd Quarter	1st	Complex numbers and polar forms	4
		2nd	Absolute values and arguments	4
		3rd	Complex functions	4
		4th	Regular functions	4
		5th	Cauchy-Riemann relation	4
		6th	Inverse functions	4
		7th	Midterm examinations	
		8th	Examination Results, Complex integrals (1)	5
	4th Quarter	9th	Complex integrals (2)	5
		10th	Complex integrals (3)	5
		11th	Cauchy's integral theorem	5
		12th	Applications of Cauchy's integral theorem	5
		13th	Cauchy's integral expression	5
		14th	Problem exercises	5
		15th	Final examinations	
		16th	Examination Results	

Evaluation Method and Weight (%)			
	Examination	Quiz/Assignment/Attendance	Total
Subtotal	70	30	100
Basic Proficiency	70	30	100
Specialized Proficiency	0	0	0
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Probability and Statistics

Course Information			
Course Code	140402	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	高専テキストシリーズ　確率統計　高専の数学教材研究会編(森北出版)		
Instructor			

Course Objectives

1. Perform simple statistical processing on one-dimensional data
2. Calculate correlation coefficients and regression lines for two-dimensional data
3. Understand the meaning of probability and be able to calculate
4. Understand the meaning of probability distribution and be able to calculate mean and variance
5. Calculate probability, mean, and variance of binomial distribution
6. Calculate probability of normal distribution

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to calculate the representative value and the degree of scatter, and explain the meaning of the degree of dispersion for one-dimensional data	Able to calculate the representative value and the degree of scatter for one-dimensional data	Unable to calculate mean/variance for one-dimensional data□
Achievement 2	Able to find correlation coefficients and regression line equations for two-dimensional data, and explain what they are used for	Able to obtain correlation coefficients and regression line equations for two-dimensional data	Unable to obtain the correlation coefficient/regression line equation for two-dimensional data
Achievement 3	Able to calculate probability using addition and multiplication theorems, and explain the meaning of independence of events	Able to calculate probability using addition and multiplication theorems	Unable to calculate probability
Achievement 4	Able to calculate the mean and variance of random variables, and understand the mean of functions of random variables	Able to compute the mean and variance of random variables	Unable to compute mean and variance of random variables

Achievement 5	Able to apply binomial distribution calculations to specific problems	Able to calculate probability distribution for binomial distribution	Unable to compute probability distribution for binomial distribution
Achievement 6	Able to apply normal distribution calculations to specific problems	Able to compute probabilities by standardizing on general normal distributions	Unable to calculate probability for general normal distribution

Assigned Department Objectives	
Fundamental Scientific Knowledge (A)	
Teaching Method	
Outline	Understand the basics of probability and statistics and be able to perform basic calculations.
Style	Classes will be conducted in a lecture format, and exercises will be conducted as appropriate. In addition, assignments will be given as necessary.
Notice	You will need a calculator (one that can calculate square roots) in class.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	How to proceed with the class, frequency distribution table, representative values	1
		2nd	Variance and standard deviation	1
		3rd	Correlation	2
		4th	Regression line	2
		5th	Trials and events	3
		6th	Meaning and properities of probability	3
		7th	Midterm examination	
		8th	Iterative trial	3
	4th Quarter	9th	Conditional probability	3
		10th	Random variables and probability distributions	4
		11th	Mean of a random variable	4
		12th	Variance of the probability distribution	4
		13th	Binomial distribution	5
		14th	Normal distribution	6
		15th	Final examination	
		16th		

Evaluation Method and Weight (%)

	Examination	Assignments	Total
Subtotal	80	20	100
Basic Proficiency	0	0	0
Specialized Proficiency	80	20	100
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Advanced Seminar in Mathematics

Course Information

Course Code	140416	Course Category	Specialized / Elective
Class Format	Seminar	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	高専テキストシリーズ 基礎数学・線形代数・微分積分 1 ・微分積分 2 高専の数学教材研究会編 （森北出版）、 高専テキストシリーズ 基礎数学・線形代数・微分積分 1 ・微分積分 2 問題集 高専の数学教材研究会編（森北 出版）		
Instructor			

Course Objectives

1. Understand identities, equations, inequalities, basic functions and graphs, and plane figures and their calculations
2. Understand and calculate the number of cases and probabilities
3. Understand and calculate plane vectors, space vectors, matrices, determinants, eigenvalues, and the diagonalization of matrices
4. Understand the limits and derivatives of functions of one variable and integrals and their calculations
5. Understand and calculate higher derivatives, series, bivariate functions, partial derivatives, advanced integrals,and multiple integrals
6. Understand and calculate first- and second-order differential equations

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to solve applied problems related to identities, equations, inequalities, basic functions and graphs, and plane figures	Able to understand and solve problems related to identities, equations, inequalities, basic functions and graphs, and plane figures	Unable to solve problems involving identities, equations, inequalities, basic functions and graphs, and plane figures
Achievement 2	Able to solve applied problems related to vectors, matrices, determinants, eigenvalues, and the diagonalization of matrices	Able to understand and solve problems related to vectors, matrices, determinants, eigenvalues, and the diagonalization of matrices	Unable to solve problems involving vectors, matrices, determinants, eigenvalues, and the diagonalization of matrices
Achievement 3	Able to solve application problems related to limits, differentiation, and the integration of functions of one variable	Able to understand limits, differentiation, and the integration of functions of one variable and be able to solve problems	Unable to solve problems related to limits, differentiation, and the integration of functions of one variable
Achievement 4	Able to solve applied problems related to higher derivatives, series, bivariate functions, partial derivatives, advanced integrals, and multiple integrals	Able to understand and solve problems involving higher derivatives, series, bivariate functions, partial derivatives, advanced integrals, and multiple integrals	Unable to solve problems involving higher derivatives, series, bivariate functions, partial derivatives, advanced integrals, and multiple integrals

Achievement 5	Able to solve application problems related to first- and second-order differential equations	Able to understand first- and second-order differential equations and able to solve problems	Unable to solve problems involving first- and second-order differential equations

Assigned Department Objectives	
Fundamental Scientific Knowledge (A)	
Teaching Method	
Outline	The goal is to help students understand and establish the mathematical knowledge they have learned so far and to acquire mathematical problem-solving skills. In addition, to improve mathematics literacy, more advanced content and highly abstract content are also handled.
Style	1. We will practice problems with printouts, but new content will be covered in online lectures. 2. The first half of the practice is basic exercises, and the second half is comprehensive exercises, with a focus on group work. 3. For basic exercises, each group is in charge and writes on the blackboard for presentation. 4. The exercises in the second half will be submitted. 5. Online teaching materials will be prepared for new content, so please prepare as much as possible.
Notice	Carefully read the course handbook to confirm the relationship between the conditions for advancing to the fifth year of each department and the conditions for graduation. Also, please note that this subject is not subject to confirmation exams. If the student decides to cancel the course, they must complete the procedure by the end of April. We welcome students who can actively participate in exercises.

Characteristics of Class / Division in Learning			
☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Class format, review of basic mathematics	1
		2nd	Spatial figures	2
		3rd	Ranks and simultaneous linear equations	2
		4th	Comprehensive exercises on ranks	2
		5th	Determinants	2
		6th	Comprehensive exercises	
		7th	Mid-term exams	
		8th	Test return, diagonalization of matrices and inverse matrices	2
	2nd Quarter	9th	Diagonalization of symmetric matrices	2
		10th	Linear dependence and independence	2
		11th	Bases and dimensions of vector space	2
		12th	Nuclei of solution spaces and linear mapping	2
		13th	Subspaces spanned by vectors and linear map	2

		14th	Comprehensive exercises	
		15th	Final exam	
		16th	Test return, derivatives of functions with one variable	3
2nd Semester	3rd Quarter	1st	Limits of functions with one variable	3
		2nd	Applications of differentiation	3
		3rd	Integration of one variable	3
		4th	Partial derivatives	4
		5th	Maxima and minima	4
		6th	Comprehensive exercises	
		7th	Mid-term exams	4
		8th	Test return, implicit functions, tangents and tangent planes	4
	4th Quarter	9th	Iterated integration	4
		10th	Multiple integrals of changing variables	
		11th	First-order differential equations (variable separable, homogeneous, permutation)	5
		12th	First-order differential equations (Bernoulli type, complete differential type)	5
		13th	Second-order differential equations	5
		14th	Comprehensive exercises	
		15th	Final exam	
		16th	Test return, simultaneous differential equations	5

Evaluation Method and Weight (%)

	Examination	Presentation or assignment submission	Total
Subtotal	50	50	100
Basic Proficiency	50	50	100
Specialized Proficiency	0	0	0
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Applied Physics 1

Course Information			
Course Code	121301	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Electrical Engineering and Information Science	Student Grade	3rd
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	高専テキストシリーズ　物理（上）力学・波動　潮 秀樹 監修　森北出版、初歩から学ぶ基礎物理学　力学II　柴田洋一　他　大日本図書		
Instructor			

Course Objectives

1. Able to understand, explain, and calculate phenomena related to sound waves
2. Able to understand, explain, and calculate phenomena related to light waves
3. Able to express basic methods of calculating physical quantity using differentiation and integration, and calculate them
4. Able to express equations of motion as differential equations and calculate their solutions
5. Able to understand angular momentum and use it to calculate the equation of motion of rotation

Rubric

	Idea Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand and explain phenomena related to sound waves and solve advanced problems	Able to solve basic problems related to phenomena related to sound waves	Unable to understand phenomena related to sound waves
Achievement 2	Able to understand and explain phenomena related to light waves and to solve advanced problems	Able to solve basic problems related to phenomena related to light waves	Unable to understand phenomena related to light waves
Achievement 3	Able to explain and calculate various physical quantities using calculus	Able to calculate basic physical quantities using calculus	Unable to explain basic quantities using calculus
Achievement 4	Able to set up an equation of motion using a differential equation and find its solution	Able to establish equations of motion using differential equations	Unable to establish equations of motion using differential equations
Achievement 5	Able to understand and explain physical quantities related to rotational motion and be able to calculate them	Able to calculate physical quantities related to rotational motion	Unable to understand the physical quantities involved in rotational motion

Assigned Department Objectives

Fundamental Scientific Knowledge (A)

Teaching Method

Outline	In Applied Physics 1, the students will learn about sound waves and light waves as a continuation of wave motion in the first half. In the second half, the students will learn about the dynamics of mass points using differential and integral expressions and their calculations. Finally, the students will learn about angular momentum and moment of inertia, which are physical quantities of rotation.
Style	The class will be conducted in a lecture format. In the first semester, the students will focus on sound waves and light waves based on the course contents on wave motion learned in the second year. In the second semester, the students will return to the content on dynamics and use differentiation and integration to express and calculate the relationships between various dynamic physical quantities that they learned in the first and second years. In addition to simple differentials and integrals, calculations of differential equations as equations of motion are discussed. Rotational motion is also handled using differentiation and integration. In both cases, exercises using examples will be conducted after the lecture.

Notice	Preliminary learning: The first semester will be based on the knowledge of "waves" learned in Physics 2; therefore, please review it carefully. The second semester requires knowledge of differential calculus, integral calculus, and differential equations; thus, please review the mathematics in these fields carefully. If you get promoted without earning these credits, you can take the credit confirmation test (once) in the year of promotion if you score 40 points or higher.

Characteristics of Class / Division in Learning

☐ Active Learning	☑ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Guidance and basics of sound waves (speed, triads, reflections, refractions)	1
		2nd	Diffraction, interference, and beats of sound waves	1
		3rd	Natural vibration of strings	1
		4th	Natural vibration and resonance of air columns	1
		5th	Doppler effect 1 (sound source movement)	1
		6th	Doppler effect 2 (observer movement)	1
		7th	Midterm examination	1
		8th	Return of answers and basics of light waves (speed, reflection, and refraction)	1,2
	2nd Quarter	9th	Diffraction and interference of light 1 (Young's experiment)	2
		10th	Diffraction/interference of light 2 (diffraction grating, interference by thin film)	2
		11th	Diffraction and interference of light 3 (Newton rings, etc.)	2
		12th	Light and lens	2
		13th	Images through lens	2
		14th	Lens formula	2
		15th	Final examination	2
		16th		
2nd Semester	3rd Quarter	1st	Position, velocity, and acceleration 1 (linear motion)	3
		2nd	Position, velocity, and acceleration 1 (planar motion)	3
		3rd	Work and power 1 (conservative force)	3
		4th	Work and power 2 (non-conservative force)	3
		5th	Potential energy	3
		6th	Kinetic energy, impulse, and momentum	3
		7th	Midterm examination	3
		8th	Return of answers and equation of motions (differential equation)	4
	4th Quarter	9th	Solving differential equations 1 (Motion with air resistance)	4
		10th	Solving differential equations 2 (Motion with a spring)	4
		11th	Practicing solving differential equations	4
		12th	Moment of force and angular momentum	5
		13th	Equation of motion for angular momentum	5
		14th	Moment of inertia	5
		15th	Final examination	4,5
		16th		

Evaluation Method and Weight (%)							
	Examination	Submission of assingments	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	80	20	0	0	0	0	100
Basic Proficiency	80	20	0	0	0	0	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Applied Physics 2

Course Information			
Course Code	140404	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	初歩から学ぶ基礎物理学　力学Ⅱ　（大日本図書）		
Instructor			

Course Objectives

1. Calculate the system of masses and the center of gravity of rigid bodies□
2. Understand the motion of the center of gravity in a system of masses and the motion of the center of gravity
3. Understand the equation of motion for rotation and be able to perform calculations
4. Understand the meaning of moment of inertia and calculate it for mass points and rigid bodies
5. Formulate the necessary equations of motion for the motion of a rigid body and solve them comprehensively

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand the meaning of center of gravity and compute the center of gravity of mass systems and rigid bodies	Able to understand the meaning of the center of gravity and calculate the center of gravity of a system of masses	Unable to calculate the center of gravity of mass systems
Achievement 2	Able to understand the motion of the center of gravity, including collisions, and the relative motion of each mass with respect to the center of gravity, and calculate their physical quantities	Able to understand the motion of the center of gravity including collisions in a mass system and calculate its physical quantity	Unable to calculate the physical quantity for the motion of the center of gravity in the mass system
Achievement 3	Able to understand the relationship between physical quantities related to rotation, and be able to set up differential equations and perform calculations	Able to understand the relationship between physical quantities related to rotation	Unable to understand the relationship of physical quantities related to rotation
Achievement 4	Able to understand the meaning of moment of inertia and calculate the moment of inertia of mass points and rigid bodies	Able to understand the basic meaning of moment of inertia and be able to calculate the moment of inertia of mass points	Unable to calculate moment of inertia of mass points

Achievement 5	Able to formulate the necessary equations of motion for the motion of a rigid body and solve them comprehensively	Able to set up the necessary equations of motion for the motion of a rigid body	Unable to formulate the necessary equations of motion for the motion of a rigid body
Assigned Department Objectives			
Fundamental Scientific Knowledge(A)			
Teaching Method			
Outline	In Applied Physics 2, following Applied Physics 1, after learning the dynamics of a mass system (two systems) using differentiation and integration, students will learn about the mechanics of rigid bodies.		
Style	Students must read the contents of the textbooks and handouts corresponding to the "class content" in advance. In addition to thoroughly reviewing dynamics using calculus from Applied Physics 1, students should also have a firm understanding of calculus and integrals learned in mathematics.		
Notice	This course ends in the first semester, and students have two opportunities to take the exam. If a student advances to the next year without earning these credits, they can take the credit confirmation test in the year in which they advance to the next year if their grade is 40 points or higher.		
Characteristics of Class / Division in Learning			
☐ Active Learning	☑ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Guidance and center of gravity of mass system	1
		2nd	Motion of the center of gravity	2
		3rd	Relative motion and reduced mass	2
		4th	Collision (conservation of momentum and coefficient of restitution)	2
		5th	Angular momentum and law of conservation of angular momentum	3
		6th	Motion relative to the motion of the center of mass	2,3
		7th	Midterm examination	1,2,3
		8th	Return of examination and center of gravity of rigid bodies	1,2
	2nd Quarter	9th	Rotational Motion Equations 1	3,4
		10th	Moment of inertia	3,4
		11th	Calculation of the moment of inertia	3,4
		12th	Theorem on the moment of inertia	4
		13th	Equations of Motion of Rigid Bodies 1	3,4,5
		14th	Equations of Motion of Rigid Bodies 2	3,4,5
		15th	Final exam	3,4,5
		16th	Test return, summary	1,3,4,5

Evaluation Method and Weight (%)							
	Examination	Tasks	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	80	20	0	0	0	0	100
Basic Proficiency	80	20	0	0	0	0	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Applied Physics 3

Course Information			
Course Code	140405	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	高専テキストシリーズ　物理下（熱・電磁気・原子）　潮 秀樹 監修　森北出版		
Instructor			

Course Objectives

1. Able to understand electric fields and potentials
2. Able to calculate capacitances
3. Able to use Ohm's law and Kirchhoff's law
4. Able to understand the relationship between direct current and magnetic field
5. Able to understand the relationship between current and force in a magnetic field
6. Able to understand the laws of electromagnetic induction

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to solve advanced problems of electric fields and potentials	Able to solve basic problems of electric fields and potentials	Unable to solve basic problems of electric fields and potentials
Achievement 2	Able to solve advanced problems about capacitors	Able to solve basic problems about capacitors	Unable to solve basic problems about capacitors
Achievement 3	Able to solve advanced problems using Ohm's law and Kirchhoff's law	Able to solve basic problems using Ohm's law and Kirchhoff's law	Unable to solve basic problems using Ohm's law and Kirchhoff's law
Achievement 4	Able to understand the relationship between direct current and magnetic field and solve advanced problems	Able to understand the relationship between direct current and magnetic field and solve basic problems	Unable to understand the relationship between direct current and magnetic field
Achievement 5	Able to understand the relationship between current and force in a magnetic field and solve advanced problems	Able to understand the relationship between current and force in a magnetic field and solve basic problems	Unable to understand the relationship between current and force in a magnetic field
Achievement 6	Able to understand the laws of electromagnetic induction and solve advanced problems	Able to understand the laws of electromagnetic induction and solve basic problems	Unable to understand the laws of electromagnetic induction

Assigned Department Objectives	
Fundamental Scientific Knowledge(A)	
Teaching Method	
Outline	This course focuses on content related to electromagnetism. Learn the basics of electromagnetism, such as electric fields and potentials, electric currents and magnetic fields, and alternating current.
Style	Be sure to thoroughly review the mechanics of Physics 1 and Physics 2, as well as differential and integral calculus in mathematics. This course is related to Applied Chemistry Exercise 2.
Notice	This course is related to [Compulsory Elective Courses (Special case C②)]. This course is only available in the second semester, with not more than two opportunities to take the exam. Even if you get promoted without earning credits, you cannot take the credit confirmation test if you score less than 40 points.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Orientation, Electric field, Coulomb's Law	1
		2nd	Electric potential and electric potential difference	1
		3rd	Electric potential around a point charge	1
		4th	Capacitor 1	2
		5th	Capacitor 2	2
		6th	Kirchhoff's law	3
		7th	Problem exercises	1,2,3
		8th	Midterm examination	1,2,3
	2nd Quarter	9th	Results of examination Conclusion of first semester	1,2,3
		10th	Magnetic field created by electric current	4
		11th	Force received by the current from the magnetic field	5
		12th	Lorentz force	5
		13th	Electromagnetic induction	6
		14th	Alternating current	6
		15th	Problem exercises	4,5,6
		16th	Final examination	4,5,6

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	70	0	0	0	0	30	100
Basic Proficiency	70	0	0	0	0	30	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Inorganic Chemistry 1

Course Information			
Course Code	140303	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	New Tech Chemistry Series - Inorganic Chemistry by Nozomi Uchida et al. (Asakura Shoten)		
Instructor			

Course Objectives

1. Understand the structure of an atom.
2. Understand ionic and covalent bonding.
3. Understand the chemical formulas and names of inorganic compounds.
4. Understand the structures and properties of coordination bonds and complexes.
5. Understand band structures.
6. Understand amorphous solids.
7. Understand the basic properties and applications of typical elements.
8. Understand entry-level intellectual property.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand and explain the structure of an atom.	Able to understand the structure of an atom.	Unable to understand the structure of an atom.
Achievement 2	Able to understand and explain ionic and covalent bonding.	Able to understand ionic and covalent bonding.	Unable to understand ionic and covalent bonding.
Achievement 3	Able to understand and explain chemical formulas and names of inorganic compounds.	Able to understand the chemical formulas and names of inorganic compounds.	Unable to understand the chemical formulas and names of inorganic compounds.
Achievement 4	Able to understand and explain coordination bonds and complexes.	Able to understand coordination bonds and complexes.	Unable to understand coordination bonds and complexes.
Achievement 5	Able to understand and explain band structures.	Able to understand band structures.	Unable to understand band structures.
Achievement 6	Able to understand and explain amorphous solids.	Able to understand amorphous solids.	Unable to understand amorphous solids.
Achievement 7	Able to understand and explain the basic properties and applications of typical elements.	Able to understand the basic properties and applications of typical elements.	Unable to understand the basic properties and applications of typical elements.
Achievement 8	Able to understand and explain entry-level intellectual property.	Able to understand entry-level intellectual property.	Unable to understand entry-level intellectual property.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	The goal is to introduce specialized inorganic chemistry, covering topics such as atomic structure, chemical bonding, nomenclature of inorganic substances, complexes, band structures, amorphous solids, and basic information about typical elements. An additional goal involves understanding the principles of intellectual property, particularly patents and designs.
Style	The industrial sectors requiring knowledge of inorganic chemistry span various fields, including electronics, automotive, and environmental science. To enhance understanding of the link between the environment and inorganic chemistry, environmental topics will be integrated into the curriculum during weeks 4 to 7 and 9 to 14 of the latter half of the semester. Confirmatory tests and assignments will be assigned.
Notice	Based on the knowledge acquired in the first and second years of chemistry study, this course serves as an introduction to specialized inorganic chemistry. Together with Inorganic Chemistry 2, studied in the fourth year, this course covers nearly all aspects of inorganic chemistry. It is important for forming the basis for other fields of chemistry and complementing inorganic functional chemistry, materials chemistry, and intellectual property studied in the fifth year. In the field of intellectual property, particular emphasis is placed on design, with the goal of participating in the design patent contest in the following year.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Materials and atoms (1)	1
		2nd	Materials and atoms (2)	1
		3rd	Atomic nucleus and electronic structure	1
		4th	Electron configurations and the Periodic Table (1)	1
		5th	Electron configurations and the Periodic Table (2)	1
		6th	Ionic bonding and ionic crystals	2
		7th	Mid-term test	1,2
		8th	Introduction to intellectual property	8
	2nd Quarter	9th	Covalent bonding and molecular structures (1)	2
		10th	Covalent bonding and molecular structures (2)	2
		11th	Bond strength and infrared spectra	2
		12th	Chemical formulas and names of inorganic compounds	3
		13th	Coordination bonds and complex structures (1)	4
		14th	Coordination bonds and complex structures (2)	4
		15th	End-of-term test	2,3,4
		16th	Band structures of solids (1)	5

2nd Semester	3rd Quarter	1st	Band structures of solids (2)	5
		2nd	Amorphous solids	+
		3rd	Chemistry of typical non-metal elements (hydrogen)	7
		4th	Chemistry of typical non-metal elements (carbon)	7
		5th	Chemistry of typical non-metal elements (nitrogen, oxygen)	7
		6th	Chemistry of typical non-metal elements (halogens, noble gases)	7
		7th	Mid-term test	5,6,7
		8th	Chemistry of typical non-metal elements (silicon (1))	7
	4th Quarter	9th	Chemistry of typical non-metal elements (silicon (2))	7
		10th	Chemistry of typical non-metal elements (phosphorus)	7
		11th	Chemistry of typical non-metal elements (sulfur)	7
		12th	Chemistry of typical metal elements (alkali metals, alkaline earth metals)	7
		13th	Chemistry of typical metal elements (aluminum)	7
		14th	Chemistry of typical metal elements (tin, lead)	7
		15th	End-of-term test	7
		16th	Introduction to intellectual property	8

Evaluation Method and Weight (%)

	Examination	Assignments	Quiz	Total
Subtotal	80	15	5	100
Basic Proficiency	20	5	5	30
Specialized Proficiency	50	5	0	55
Cross Area Proficiency	10	5	0	15

Niihama College	Year	2023	Course Title	Inorganic Chemistry 2

Course Information

Course Code	140468	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	ニューテック化学シリーズ　無機化学　　内田希　他著　　（朝倉書店）、工学のための無機化学［新訂版］　橋本和明　他著　（サイエンス社）		
Instructor			

Course Objectives

1. Understand the fundamentals of oxidation-reduction and ironmaking.
2. Understand batteries and electrolysis.
3. Systematically understand Arrhenius acids and bases, Bronsted acids and bases, and Lewis acids and bases.
4. Understand nuclear power generation.
5. Understand X-rays, their use, and the crystal structures of inorganic compounds.
6. Interpret phase diagrams for binary systems.
7. Systematically understand the properties of representative elements (metals) among typical elements.
8. Systematically understand the properties of representative transition metal elements.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand and explain the fundamentals of oxidation-reduction and ironmaking.	Able to understand the fundamentals of oxidation-reduction and ironmaking.	Unable to understand the fundamentals of oxidation-reduction and ironmaking.
Achievement 2	Able to understand and explain batteries and electrolysis.	Able to understand batteries and electrolysis.	Unable to understand batteries and electrolysis.
Achievement 3	Able to systematically understand and explain Arrhenius acids and bases, Bronsted acids and bases, and Lewis acids and bases.	Able to systematically understand Arrhenius acids and bases, Bronsted acids and bases, and Lewis acids and bases.	Unable to systematically understand Arrhenius acids and bases, Bronsted acids and bases, and Lewis acids and bases.
Achievement 4	Able to understand and explain nuclear power generation.	Able to understand nuclear power generation.	Unable to understand nuclear power generation.
Achievement 5	Able to understand and explain X-rays, their use, and the crystal structures of inorganic compounds.	Able to understand X-rays, their use, and the crystal structures of inorganic compounds.	Unable to understand X-rays, their use, and the crystal structures of inorganic compounds.
Achievement 6	Able to interpret and explain phase diagrams for binary systems.	Able to interpret phase diagrams for binary systems.	Unable to interpret phase diagrams for binary systems.

Achievement 7	Able to systematically understand and explain the properties of representative elements (metals) among typical elements.	Able to systematically understand the properties of representative elements (metals) among typical elements.	Unable to systematically understand the properties of representative elements (metals) among typical elements.
Achievement 8	Able to systematically understand and explain the properties of representative transition metal elements.	Able to systematically understand the properties of representative transition metal elements.	Unable to systematically understand the properties of representative transition metal elements.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	The goal is to understand and acquire fundamental knowledge related to current industrial examples in the fields of oxidation-reduction, acids and bases, nuclear power generation, X-rays and their applications, crystal structures, phase diagrams for binary systems, as well as the basic properties of typical elements (metals and transition metals).
Style	The industrial sectors requiring knowledge of inorganic chemistry encompass various fields, including electronics, automotive, and environmental science. To enhance understanding of the interplay between the environment and inorganic chemistry, environmental topics will be integrated into the curriculum during weeks 12 to 14 of the first semester and weeks 5, 6, 10–14, and 16 of the second semester. Confirmatory tests and assignments will be given.
Notice	Coupled with Inorganic Chemistry 1, studied in the third year, this course covers almost all aspects of inorganic chemistry. Along with inorganic functional chemistry, materials chemistry, and intellectual property, which are studied in the fifth year, this course is also important in forming a basis for other fields of chemistry.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Oxidation and reduction	1
		2nd	State of existence of elements and isolation/refining/steelmaking	1
		3rd	Standard redox potential and chemical batteries (1)	2
		4th	Standard redox potential and chemical batteries (2)	2
		5th	Standard redox potential and chemical batteries (3)	2
		6th	Electrolysis	2
		7th	Mid-term test	1, 2
		8th	Arrhenius and Bronsted acids and bases	3
		9th	Lewis acids and bases	3
		10th	Nuclear power generation (1)／p. 28, 29	4

	2nd Quarter	11th	Nuclear power generation（2）／p28, 29	4
		12th	Chemistry of transition metal elements (iron, cobalt, nickel)	8
		13th	Chemistry of transition metal elements (copper, silver, gold)	8
		14th	Chemistry of transition metal elements (zinc, cadmium, mercury)	8
		15th	End-of-term test	3,4,8
		16th	Characterization of crystal structures: X-ray diffraction (1)	5
2nd Semester	3rd Quarter	1st	Characterization of crystal structures: X-ray diffraction（2）	5
		2nd	Characterization of crystal structures: X-ray diffraction（3）	5
		3rd	X-ray fluorescence analysis	5
		4th	Lattice defects and non-stoichiometric composition/p. 96,97	5
		5th	Chemistry of typical metal elements (boron) / p. 132, 133	7
		6th	Chemistry of typical metal elements (arsenic, antimony, bismuth)/p. 152–155	7
		7th	Mid-term test	5,7
		8th	Phase diagrams for binary systems (1)	6
	4th Quarter	9th	Phase diagrams for binary systems（2）	6
		10th	Chemistry of transition metal elements (titanium, photocatalysis)/p. 164, 165	8
		11th	Chemistry of transition metal elements (zirconium, hafnium)/p. 168,169	8
		12th	Chemistry of transition metal elements (rare earth elements)/p. 160, 187	8
		13th	Chemistry of transition metal elements (superconductors)/p. 186, 161	8
		14th	Chemistry of transition metal elements (vanadium, chromium, manganese)/p. 170–175	8
		15th	End-of-term test	6,8
		16th	Chemistry of transition metal elements (advanced materials)	7,8

Evaluation Method and Weight (%)

	Examination	Assignments	Quiz	Total
Subtotal	80	15	5	100
Basic Proficiency	0	0	5	5
Specialized Proficiency	80	5	0	85
Cross Area Proficiency	0	10	0	10

Niihama College	Year	2023	Course Title	Organic Chemistry 2

Course Information			
Course Code	140304	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	ハート基礎有機化学　H.ハート著　秋葉欣哉　他訳　（培風館）および配布プリント		
Instructor			

Course Objectives

1. Understand the concepts of atomic and molecular orbitals and be able to draw the electron states and structures of hybrid orbitals.
2. Based on the concept of hybrid orbitals, represent the molecular structure of typical organic compounds in three dimensions.
3. Explain the concept of the energy barrier in reactions and the energy changes during reactions using diagrams.
4. Use various symbols used in reaction mechanisms.
5. Define nucleophilic and electrophilic reagents, acids, and bases and illustrate their respective functions.
6. Explain the characteristics and reactions of alkanes, alkenes, and alkynes.
7. Explain the mechanism of electrophilic addition reactions in alkenes, particularly Markovnikov's rule.
8. Explain the mechanism of nucleophilic substitution reactions and elimination reactions.
9. Discuss the stability of carbon ions from the perspective of inductive and resonance effects.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand the concepts of atomic and molecular orbitals and draw the electron states and structures of hybrid orbitals.	Able to draw the electron states and structures of hybrid orbitals, but unable to link them to the concept of molecular orbitals.	Does not understand the concept of atomic orbitals and molecular orbitals.
Achievement 2	Able to represent the molecular structure of typical organic compounds in three dimensions based on the concept of hybrid orbitals.	Able to represent the molecular structure of typical organic compounds in three dimensions, but unable to link them to the concept of hybrid orbitals.	Unable to represent the molecular structure of typical organic compounds in three dimensions.
Achievement 3	Able to explain the concept of the energy barrier in reactions and the energy changes during reactions using diagrams.	Able to interpret energy diagrams of reactions but unable to explain the concepts and diagrams in relation to one another.	Does not understand how to interpret energy diagrams of reactions.
Achievement 4	Able to use various symbols used in reaction mechanisms.	Knows the various symbols used in reaction mechanisms but unable to use them appropriately.	Does not know the various symbols used in reaction mechanisms.
Achievement 5	Knows the definitions of nucleophilic and electrophilic reagents, acids, and bases and able to illustrate their respective functions.	Knows the definitions of nucleophilic and electrophilic reagents, acids, and bases but unable to illustrate their respective functions.	Does not know the definitions of nucleophilic and electrophilic reagents, acids, and bases.

Achievement 6	Able to explain all the characteristics and reactions of alkanes, alkenes, and alkynes, relating them together.	Unable to relate the characteristics and reactions of either alkanes, alkenes, or alkynes.	Unable to explain the characteristics and reactions of alkanes, alkenes, or alkynes.
Achievement 7	Able to explain the mechanism of electrophilic addition reactions of alkanes.	Knows Markovnikov's rule but cannot adequately explain its reaction mechanism.	Does not understand the definition of Markovnikov's rule.
Achievement 8	Able to explain the mechanisms of nucleophilic substitution reactions and elimination reactions based on the differences between S_N1, S_N2, E1, and E2.	Understands the general mechanisms of nucleophilic substitution reactions and elimination reactions but does not understand the differences between S_N1, S_N2, E1, and E2.	Does not understand the mechanisms of nucleophilic substitution reactions and elimination reactions.
Achievement 9	Able to discuss the stability of carbon ions from the perspective of inductive and resonance effects.	Able to evaluate the stability of various carbon ions but unable to discuss it from the perspective of inductive and resonance effects.	Unable to evaluate the stability of various carbon ions.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	The aim of this course is to understand the fundamental principles of organic chemistry, including the electronic theory and bonding of organic compounds, energy barriers in reactions, changes in energy during reactions, the significance of stereochemistry, and the conceptualization of reaction mechanisms.
Style	The lectures will be conducted based on the blackboard and PowerPoint presentations, summarizing key points in handouts. To foster the ability to visualize molecules in three dimensions, tools such as molecular models and computer graphics will be utilized.
Notice	This course builds upon the knowledge acquired in Organic Chemistry 1 and focuses on learning tools such as principles and laws to understand various phenomena related to organic chemistry, including compound properties and reaction mechanisms. The naming conventions learned in Organic Chemistry 1 remain essential in this course. Additionally, the content of this course is relevant to Biochemistry 1, which is studied in the third year, and it serves as a foundation for advanced courses like Bioorganic Chemistry 2A and 2B, Biochemistry 2, Industrial Organic Chemistry, and Functional Organic Chemistry, which are studied in the fourth year and later. It is crucial to review and thoroughly understand the fundamental concepts learned in each class.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
		1st	Chemical Bonds that Determine the Structure and Properties of Organic Compounds (1): Atomic orbitals	1

1st Semester	1st Quarter	2nd	Chemical Bonds that Determine the Structure and Properties of Organic Compounds (2): Formation of molecular orbitals and covalent bonds	1
		3rd	Chemical Bonds that Determine the Structure and Properties of Organic Compounds (3): Molecular orbitals of hydrocarbons, concept of hybridization	1,2
		4th	Chemical Bonds that Determine the Structure and Properties of Organic Compounds (3): Various hybrid orbitals in hydrocarbons	1,2
		5th	Chemical Bonds that Determine the Structure and Properties of Organic Compounds (4): Molecular orbitals of compounds containing oxygen	1,2
		6th	Chemical Bonds that Determine the Structure and Properties of Organic Compounds (5): Molecular orbitals of compounds containing nitrogen, etc.	1,2
		7th	Midterm test	
		8th	Energy Changes in Chemical Reactions of Organic Compounds (1): Various reactions and energy diagrams	1,2
	2nd Quarter	9th	Energy Changes in Chemical Reactions of Organic Compounds (2): Transition state and activation energy	3
		10th	Energy Changes in Chemical Reactions of Organic Compounds (3): Thermodynamically favorable reactions, kinetically favorable reactions	3,4
		11th	Energy Changes in Chemical Reactions of Organic Compounds (4): Stability of reaction intermediates	4
		12th	Stoichiometry and Reaction Mechanisms: Breakage and formation of covalent bonds	4
		13th	Definition of Acids and Bases: Nucleophilic reagents and electrophilic reagents	4
		14th	Chemistry of Alkanes: Reactions and synthesis	5
		15th	End-of-term test	
		16th		
2nd	3rd Quarter	1st	Chemistry of Alkanes	6
		2nd	Reactions of Alkanes (1): Markovnikov's rule	6,7
		3rd	Reactions of Alkanes (2): Markovnikov's rule and anti-Markovnikov's rule	6,7
		4th	Reactions of Alkanes (3): Free radical reactions	6,7
		5th	Reactions of Alkanes (4): Oxidation and synthesis of alkanes	6,7
		6th	Reactions and Synthesis of Alkanes	6
		7th	Midterm test	
		8th	Chemistry of Alkyl Halides	6,7

Semester	4th Quarter	9th	Chemistry of Alkyl Halides (1): S_N2 reaction	6,7
		10th	Chemistry of Alkyl Halides (2): S_N1 reaction	8
		11th	Chemistry of Alkyl Halides (3): Factors that determine the mode of S_N reaction	8
		12th	Chemistry of Alkyl Halides (4): E2 reaction	8
		13th	Chemistry of Alkyl Halides (5): E1 reaction	8
		14th	Mechanism of organic chemistry reactions: Inductive effect and resonance effect	9
		15th	End-of-year test	
		16th		

Evaluation Method and Weight (%)

	Examination	Assignments	Mutual Evaluations between students	Behavior	Portoforio	Other	Total
Subtotal	60	30	0	10	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	60	30	0	10	0	0	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Bioorganic Chemistry 1

Course Information			
Course Code	140465	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	ハート基礎有機化学　H.ハート著　秋葉欣哉　他訳（培風館）、ポイント有機化学演習　池田正澄　編（廣川書店）、配布プリント		
Instructor			

Course Objectives

1. Explain the basic naming, properties, and reactivity of organic compounds.
2. Describe the properties, synthesis, and reactions of carbonyl compounds.
3. Explain structural isomerism and stereoisomerism in organic molecules.
4. Describe the concepts of Green Chemistry.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand and accurately explain the basic naming, properties, and reactivity of organic compounds.	Able to provide a summary of the basic naming, properties, and reactivity of organic compounds.	Unable to provide a summary of the basic naming, properties, and reactivity of organic compounds.
Achievement 2	Able to understand and accurately explain the properties, synthesis, and reactions of carbonyl compounds.	Able to provide a summary of the properties, synthesis, and reactions of carbonyl compounds.	Unable to provide a summary of the properties, synthesis, and reactions of carbonyl compounds.
Achievement 3	Able to understand and accurately explain structural isomers and stereoisomers that are isomers of organic molecules.	Able to provide a summary of structural isomers and stereoisomers that are isomers of organic molecules.	Unable to provide a summary of structural isomers and stereoisomers that are isomers of organic molecules.
Achievement 4	Able to understand and accurately explain the concepts of Green Chemistry.	Able to explain the concepts of Green Chemistry.	Unable to explain the concepts of Green Chemistry.

Assigned Department Objectives

Specialized Knowledge (B)

Teaching Method

Outline	In Bioorganic Chemistry 1, students will learn about the properties, reactivity, and synthesis methods of organic compounds, classified by their functional groups. Additionally, they will explore these synthesis methods from the perspective of Green Chemistry, examining the effects of organic compounds on the environment and life, and understanding the concepts of Green Chemistry. They will be encouraged to consider not only organic chemical reactions but also biochemical synthesis within the context of organic compound synthesis.
Style	The course will be conducted in lecture format, with frequent questions to confirm understanding. Students are recommended to read the textbook for the upcoming class in advance and actively participate in discussions. They should thoroughly read the recommended books, considering topics such as the nomenclature, properties, and reactivity of organic compounds. This course is closely related to Industrial Bioorganic Chemistry 1 and 2, as well as Theoretical Organic Chemistry and Synthetic Organic Chemistry in the Applied Biological Chemistry major.
Notice	Bioorganic Chemistry 1 focuses on learning and understanding fundamental topics related to the nomenclature, reactivity, synthesis, and structural analysis of organic compounds. It is essential to review the material learned in class regularly to solidify understanding. To comprehensively study the unique properties of organic molecules and their various functions, foundational knowledge from Organic Chemistry 1, Organic Chemistry 2, Inorganic Chemistry 1, Physical Chemistry 1, Biochemistry 1, and basic knowledge from Chemistry 1 and Chemistry 2 are necessary.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Nomenclature, structure, and properties of aldehydes and ketones	1,2,3
		2nd	Synthesis of aldehydes and ketones	2
		3rd	Nucleophilic addition of aldehydes and ketones	1,2,3
		4th	Nucleophilic addition reactions with water (hydration reaction)	2
		5th	Nucleophilic addition reactions with alcohols (acetalization reaction)	2
		6th	Nucleophilic addition reactions with amines (formation of imine) and nucleophilic addition reactions with other compounds	2
		7th	Midterm test	
		8th	Nomenclature, structure and properties of carboxylic acids	1,2,3
	2nd Quarter	9th	Reactivity of carboxylic acids	2
		10th	Synthesis of carboxylic acids (Fischer esterification) and reactions	2
		11th	Chemistry and reactions of carboxylic acid derivatives; concept of environmentally friendly synthetic methods (use of raw materials compatible with Green Chemistry and renewable resources (biomass), green plastics, etc.)	2,4

		12th	Nomenclature and synthesis of carboxylic acid derivatives	1,2,3
		13th	Reactions of carboxylic acid derivatives	2
		14th	Reactions of enolate ions	2
		15th	End-of-term test	
		16th	Return of test, summary of lesson content, and confirmation	

Evaluation Method and Weight (%)

	Examination	Quiz	Assignments	Behavior	Portoforio	Other	Total
Subtotal	70	0	30	0	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	70	0	30	0	0	0	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Bioorganic Chemistry 2A

Course Information			
Course Code	140466	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	ハート基礎有機化学　H.ハート著　秋葉欣哉　他訳（培風館）、ポイント有機化学演習　池田正澄　編（廣川書店）、配布プリント		
Instructor			

Course Objectives

1. Explain the nomenclature, properties, synthesis, and reactions associated with amino compounds.
2. Describe structural- and stereo-isomers that serve as isomers of organic molecules.
3. Explain the nomenclature, properties, synthesis, and reactions associated with aromatic compounds.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand and accurately explain the properties, synthesis, and reactions associated with amino compounds.	Capable of providing a summary detailing the properties, synthesis, and reactions associated with amino compounds.	Unable to provide a summary detailing the properties, synthesis, and reactions associated with amino compounds.
Achievement 2	Able to understand and accurately explain structural and stereoisomers that serve as isomers of organic molecules.	Capable of providing a summary detailing the structural and stereoisomers that serve as isomers of organic molecules.	Unable to provide a summary detailing the structural and stereoisomers that serve as isomers of organic molecules.
Achievement 3	Able to understand and accurately explain the nomenclature, properties, synthesis, and reactions associated with aromatic compounds.	Capable of providing a summary detailing the nomenclature, properties, synthesis, and reactions associated with aromatic compounds.	Unable to provide a summary detailing the nomenclature, properties, synthesis,and reactions associated with aromatic compounds.

Assigned Department Objectives

Specialized Knowledge (B)

Teaching Method

Outline	In Bioorganic Chemistry 2A, students delve into the properties, reactivity, synthesis methods, and environmental implications of aromatic organic compounds. The course focuses on the impact of organic compounds on the environment and life from the perspective of Green Chemistry, exploring the pertinent synthesis methods and related concepts. The curriculum emphasizes the critical role of stereochemistry in synthesizing pharmaceuticals and natural products. Furthermore, students analyze the structures of simple organic compounds by interpreting instrumental analysis results.

Style	The course will be delivered in a lecture format, incorporating frequent interactive sessions to ensure comprehension. Students are strongly recommended to prepare for each class by reading the textbook in advance and actively engaging in discussions. They should thoroughly study the recommended books, which cover various topics, such as the nomenclature, properties, and reactivity of organic compounds. This course is closely linked to Industrial Bioorganic Chemistry 1 and 2, as well as Theoretical Organic Chemistry and Synthetic Organic Chemistry in the Applied Biological Chemistry major.
Notice	Bioorganic Chemistry 2A covers the fundamental topics related to the nomenclature, reactivity, and synthesis of organic compounds. To grasp and understand these basic concepts, it is essential to regularly review the material covered in class. The course provides a multidimensional understanding of the unique properties and diverse functionalities of organic molecules. To comprehensively study the unique properties of organic molecules and various functionalities, it is necessary to possess foundational knowledge acquired from Organic Chemistry 1, Organic Chemistry 2, Inorganic Chemistry 1, Physical Chemistry 1, and Biochemistry 1, as well as basic knowledge from Chemistry 1 and Chemistry 2.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Nomenclature, structure, and properties of amine derivatives	1,2
		2nd	Synthesis of amine derivatives	1
		3rd	Reaction of amine derivatives with carboxylic acids	1
		4th	Reaction of amine derivatives with carbonyl compounds	1
		5th	Asymmetric molecules, *RS* and *EZ* notations	2
		6th	Nomenclature of optical isomers and methods of their synthesis	2
		7th	Midterm test	
		8th	Definition of resonance stabilization energy and aromaticity	3
	4th Quarter	9th	Nomenclature, structure, and properties of aromatic compounds	3
		10th	Electronic effects of substituted benzene rings (inductive and resonance effects)	3
		11th	Electrophilic substitution reactions (1)	3
		12th	Electrophilic substitution reactions (2)	3
		13th	Nucleophilic substitution reaction and aromatic substitution reaction (1)	3
		14th	Nucleophilic substitution reaction and aromatic substitution reaction (2)	3
		15th	End-of-year test	3
		16th	Return of test, summary of lesson content, and confirmation	

Evaluation Method and Weight (%)							
	Examination	Quiz	Assignments	Behavior	Portoforio	Other	Total
Subtotal	70	0	30	0	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	70	0	30	0	0	0	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Bioorganic Chemistry 2B

Course Information

Course Code	140467	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	【教科書】マクマリー生物有機化学［生化学編］ 原書8版　菅原 二三男・倉持 幸司（監修、翻訳）（丸善出版）、【参考書】コーン・スタンプ生化学　田宮信雄・八木達彦　訳（東京化学同人）、生化学辞典　今堀和友・山川民夫　監修（東京化学同人）、分子細胞生物学　G.Karp　著　山本正幸・渡辺雄一郎　監訳（東京化学同人）		
Instructor			

Course Objectives

1. Explain the structures and properties of the 20 types of amino acids.
2. Explain the primary structure of peptides and proteins, as well as methods for their determination.
3. Explain the secondary and higher-order structures of peptides and proteins, along with their functions.
4. Explain the types and structures of sugars.
5. Explain what glycosides are (examples: adenosine, maltose, etc.).
6. Explain the differences in the structure and properties of simple and complex carbohydrates.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the structures and properties of the 20 types of amino acids by relating their chemical structures to their properties.	Able to explain the structures and properties of the 20 types of amino acids.	Unable to explain the structures and properties of the 20 types of amino acids.
Achievement 2	Able to explain the primary structures of peptides and proteins and methods for their determination on a chemical basis.	Able to explain the primary structures of peptides and proteins and methods for their determination.	Unable to explain the primary structures of peptides and proteins or methods for their determination.
Achievement 3	Able to visualize and explain theoretically the secondary structures and higher-order structures of peptides and proteins and their functions.	Able to explain the secondary structures and higher-order structures of peptides and proteins and their functions.	Unable to explain the secondary structures and higher-order structures of peptides and proteins and their functions.
Achievement 4	Able to explain the types and structures of sugars using chemical formulas.	Able to provide a summary of the types and structures of sugars.	Unable to give a summary of the types and structures of sugars.
Achievement 5	Able to explain what glycosides are using chemical formulas.	Able to explain what glycosides are.	Unable to explain what glycosides are.

Achievement 6	Able to provide a chemically sound explanation of the differences in the structure and properties of polysaccharides.	Able to explain the differences in the structure and properties of polysaccharides.	Unable to explain the differences in the structure and properties of polysaccharides.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	The first half of this course covers the basic structure of proteins and their various functions, and the second half focuses on the structure and functions of carbohydrates.
Style	Lectures, with the opportunity to ask questions at appropriate times.
Notice	The students will study biomolecules, proteins, and carbohydrates in detail. Students are encouraged to recognize that the chemistry of proteins and carbohydrates, along with that of lipids and nucleic acids, is crucial and should strive for learning in this area.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Introduction to amino acids and proteins	1,2,4,5,6
		2nd	Primary structure of proteins (1)	2
		3rd	Primary structure of proteins（2）	2
		4th	Secondary structure of proteins (three-dimensional structure)	3
		5th	Introduction to protein interactions and biological control (1)	2,3
		6th	Introduction to protein interactions and biological control（2）	2,3
		7th	Midterm test	
		8th	Return of test, review	
	4th Quarter	9th	Chemistry of alcohols and carbonyl compounds, chemistry of acetals	4
		10th	Carbohydrates: Biology and stereochemistry	4
		11th	Monosaccharides (1)	5
		12th	Monosaccharides（2）	5
		13th	Polysaccharides (1)	6
		14th	Polysaccharides（2）	6
		15th	End-of-term test	
		16th	Return of test, review	

Evaluation Method and Weight (%)

	Examination	Quiz	Assignments	Behavior	Portoforio	Other	Total
Subtotal	80	0	0	20	0	0	100
Basic Proficiency	40	0	0	20	0	0	60
Specialized Proficiency	40	0	0	0	0	0	40
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Industrial Bioorganic Chemistry 1

Course Information			
Course Code	140513	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	有機工業化学　川瀬　毅 著（三共出版）および配布プリント		
Instructor			

Course Objectives

1. Explain the production of petroleum products and industrial organic products in industrial organic chemistry.
2. Explain the fundamental aspects of safety measures in factory operations, including disaster prevention laws for petroleum complexes and pollution control laws.
3. Write the names and structural formulas of basic compounds in industrial organic chemistry products and explain well-known manufacturing processes.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand and explain the production of various products in industrial organic chemistry.	Understands the production of various products in industrial organic chemistry.	Does not understand the production of various products in industrial organic chemistry.
Achievement 2	Able to understand and explain the fundamental aspects of safety measures.	Understands the fundamental aspects of safety measures.	Does not understand the fundamental aspects of safety measures.
Achievement 3	Able to understand and explain the names, structural formulas, and manufacturing processes of industrial organic chemistry products.	Understand the names, structural formulas, and manufacturing processes of industrial organic chemistry products.	Does not understand the names, structural formulas, and manufacturing processes of industrial organic chemistry products.

Assigned Department Objectives

Specialized Knowledge (B)

Teaching Method

Outline	Currently, more than 80% of consumer products around us are manufactured from organic compounds. In Bioorganic Industrial Chemistry 1, based on the foundational knowledge acquired in Organic Chemistry and Bioorganic Chemistry 1, 2A, and 2B, the students will study the reactions and manufacturing processes of petrochemical products. Additionally, they will learn standard manufacturing methods and the fundamental properties of high-molecular-weight substances and functional materials. The goal is to cultivate practical knowledge and skills as a chemical engineer to contribute to the chemical industry and society.
Style	The class will be conducted in an interactive format through the submission of assignments related to the course content.

Notice	This course is a two-credit-unit course with a total study time of 90 hours (including 30 hours of class time and 60 hours of self-study). To receive credit, a mandatory 60 hours of self-study is required, which includes assignments for self-study provided by the instructor, preparation and review time for classes, discussion time for exercise assignments to deepen understanding, and study time for exam preparation. Most of our surroundings consist of industrial products, particularly organic industrial products. It is essential to understand what substances constitute them, how they are produced, and their properties, applications, and usability, as well as the industrialization process. Progress has been made in the thinking regarding these aspects, and there is room to find new challenges. Industrial Bioorganic Chemistry 1 is a meaningful subject as a foundation for making contributions to society through research and work at universities, public institutions, and companies. The relationship between global warming and fossil fuels, as well as alternative energy sources, will also be considered.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	What is industrial organic chemistry? Composition and properties of petroleum	1,2
		2nd	Refinement and conversion of petroleum	1,2
		3rd	Environmental problems and measures in the petrochemical industry (1)	1,2
		4th	Environmental problems and measures in the petrochemical industry （2）	1,2
		5th	Manufacturing of basic synthetic raw materials	3
		6th	Chemical products derived from ethylene and methods for their synthesis	3
		7th	Midterm test	3
		8th	Chemical products derived from propylene and methods for their synthesis	3
	2nd Quarter	9th	Chemical products derived from aromatic hydrocarbons and methods for their synthesis	3
		10th	Petrochemical industry (plastics) (1)	3
		11th	Petrochemical industry (plastics) (2)	3
		12th	Petrochemical industry (oils and fats)	3
		13th	Petrochemical industry (dyes)	3
		14th	Petrochemical industry (fragrances)	3
		15th	End-of-term test	
		16th	Return of test, summary of lesson content, and confirmation	

Evaluation Method and Weight (%)

	Examination	Assignments	Presentation	Behavior	Portoforio	Mutual Evaluations between students	Total
Subtotal	70	30	0	0	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	70	30	0	0	0	0	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Industrial Bioorganic Chemistry 2

Course Information

Course Code	140514	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	新高分子化学序論　伊勢典夫　他著　（化学同人）および配布プリント		
Instructor			

Course Objectives

1. Explain the structure and synthesis of polymers.
2. Describe the types of polymers, as well as their thermal and mechanical properties and functionality.
3. Explain the environmental and life impacts of polymers.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand and accurately explain the structures and synthesis of polymers.	Able to summarize the structures and synthesis of polymers.	Unable to summarize the structures and synthesis of polymers.
Achievement 2	Able to understand and accurately describe the types of polymers, as well as their thermal and mechanical properties and functionality.	Able to describe the types of polymers, as well as their thermal and mechanical properties and functionality.	Unable to describe the types of polymers, as well as their thermal and mechanical properties and functionality.
Achievement 3	Able to understand and accurately explain the environmental and life impacts of polymers.	Able to summarize the environmental and life impacts of polymers.	Unable to summarize the environmental and life impacts of polymers.

Assigned Department Objectives

Specialized Knowledge (B)

Teaching Method

Outline	Polymers, essential materials in our daily lives, are found in natural fibers, foods, and in synthetically produced plastics and films. This course explores the synthesis of polymers present in our surroundings, studies their types and properties, and delves into their environmental impact and role in life. We aim to enhance understanding through lectures centered around textbooks and handouts, supplemented with exercises.
Style	Prepare for the class by reviewing the handouts distributed during the lecture and carefully reading the recommended books. We will explore the thermal and mechanical properties and functionality of polymers. This course is closely related to Biological Organic Industrial Chemistry 1 and intersects with theoretical organic chemistry and organic synthesis chemistry in the Applied Biological Chemistry major.
Notice	This course is a two-unit subject, requiring a total study time of 90 hours, which includes 30 hours of class time and 60 hours of mandatory self-study. To earn credits, the 60 hours of self-study must include assignments provided by the instructor, preparation and review for classes, contemplation time for exercises to deepen understanding, and study time for exam preparation. To comprehensively study the unique properties that arise when molecules become large, such as in polymers, and acquire various functions, a foundational knowledge of organic chemistry is essential, specifically Biological Organic Chemistry 1, 2A, 2B, and Physical Chemistry.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	History of the establishment of the concept of polymers	1,2
		2nd	Polymer synthesis: Radical polymerization 1 (monomer)	1,2
		3rd	Polymer synthesis: Radical polymerization 2 (initiation reaction/stopping reaction)	1,2
		4th	Polymer synthesis: Radical polymerization 3 (growth reaction)	1,2
		5th	Polymer synthesis: Radical polymerization 4 (copolymerization, polymerization method)	1,2
		6th	Polymer synthesis: Polyaddition/addition condensation (thermosetting resin), ring-opening polymerization	1,2,3
		7th	Mid-term test	
		8th	Polymer synthesis: Ionic polymerization (anionic polymerization 1)	1,2
	4th Quarter	9th	Polymer synthesis: Ionic polymerization (anionic polymerization 2)	1,2
		10th	Polymer synthesis: Ionic polymerization (cationic polymerization 1)	1,2
		11th	Polymer synthesis: Ionic polymerization (cationic polymerization 2)	1,2
		12th	Polymer reaction: conversion of functional groups (synthetic and natural polymers)	1,2,3
		13th	High-performance polymer materials: Heat-resistant polymers	1,2
		14th	High-performance polymer materials: High-strength and high-elasticity polymers	1,2
		15th	End-of-term test	
		16th	Return of test, summary of lesson content, and review	

Evaluation Method and Weight (%)

	Examination	Assignments	Presentation	Behavior	Portoforio	Mutual Evaluations between students	Total
Subtotal	70	30	0	0	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	70	30	0	0	0	0	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Physical Chemistry 1

Course Information			
Course Code	140305	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	PEL物理化学　福地賢治　編著（実教出版）		
Instructor			

Course Objectives

1. Understand the concept of significant figures, including the correct use of units of measurement.
2. Explain basic terms.
3. Explain state diagrams and the Clausius–Clapeyron equation.
4. Calculate vapor pressure and boiling point using the Clausius-Clapeyron equation in the vapor-liquid equilibrium of a one-component system.
5. Derive the ideal gas state equation from Boyle's law and Charles's law.
6. Use Dalton's law to calculate partial pressures in a mixture of gases.
7. Demonstrate the relationship between pressure and average velocity of an ideal gas using the kinetic theory of gas molecules.
8. Understand the differences between ideal and real gases and derive the van der Waals state equation.
9. Use the van der Waals state equation to express critical pressure, critical temperature, and critical volume and derive the virial state equation.
10. Explain Henry's law and Raoult's law in the vapor-liquid equilibrium of a two-component system.
11. Explain the system, surroundings, and state quantities, and provide examples of extensive and intensive state quantities.
12. Calculate work done with volume change and heat with temperature change.
13. Explain the first law of thermodynamics and express it in a formula.
14. Calculate the internal energy and enthalpy changes accompanying a state change.
15. Explain the difference between heat capacity at constant pressure and constant volume and express it in a formula.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Understands the calculation method for significant figures and can determine numerical values to the specified number of digits. Able to assign the correct units to numerical values using different representations.	Able to perform numerical calculations considering significant figures and correctly assign units for numerical values.	Unable to perform numerical calculations considering significant figures and correctly assign units for numerical values.
Achievement 2	Able to explain basic terms using formulas.	Able to explain basic terms using formulas.	Unable to explain basic terms using formulas.
Achievement 3	Able to explain the Clausius-Clapeyron equation in relation to a phase diagram.	Able to explain the Clausius–Clapeyron equation in relation to a phase diagram.	Unable to explain phase diagrams or the Clausius–Clapeyron equation.

Achievement 4	Able to explain the relationship between vapor pressure and boiling point, as well as that between external pressure and freezing point, using the Clausius–Clapeyron equation for a single-component system, and can calculate these values.	Able to calculate vapor pressure and boiling point using the Clausius–Clapeyron equation for a single-component system in vapor-liquid phase equilibrium.	Unable to calculate vapor pressure and boiling point using the Clausius–Clapeyron equation for a single-component system in vapor-liquid phase equilibrium.
Achievement 5	Able to express the gas constant by combining Avogadro's law with Boyle's law and Charles's law.	Able to derive the ideal gas state equation from Boyle's law and Charles's law.	Unable to derive the ideal gas state equation from Boyle's law and Charles's law.
Achievement 6	Able to calculate the partial pressure of a mixed gas using pressure and Dalton's law and can explain partial pressures.	Able to calculate the partial pressure of a mixed gas using the pressure and Dalton's law.	Unable to calculate the partial pressure of a mixed gas using the pressure and Dalton's law.
Achievement 7	Able to derive the relationship between pressure and average molecular velocity and calculate the root mean square velocity. Able to use the Maxwell–Boltzmann velocity distribution to determine average and maximum velocities.	Able to demonstrate the relationship between pressure and average molecular velocity and calculate the root mean square velocity.	Unable to calculate the root mean square velocity from the relationship between pressure and average molecular velocity.
Achievement 8	Able to explain the difference between ideal and real gases. Able to derive the van der Waals equation.	Able to explain the difference between ideal and real gases. Able to derive the van der Waals equation.	Unable to explain the difference between ideal and real gases. Unable to derive the van der Waals equation.
Achievement 9	Able to derive formulas for critical pressure, critical temperature, and critical volume using the van der Waals state equation. Able to derive the virial equation of state.	Able to use the van der Waals equation of state to represent critical pressure, critical temperature, and critical volume. Able to derive the virial equation of state.	Unable to use the van der Waals equation of state to represent critical pressure, critical temperature, and critical volume. Unable to derive the virial equation of state.
Achievement 10	Able to use Raoult's law and Henry's law for a binary system in vapor-liquid equilibrium and calculate the compositions of liquid and vapor phases.	Able to calculate the compositions of liquid and vapor phases for a binary system in vapor-liquid equilibrium using Raoult's law and Henry's law.	Unable to calculate the compositions of liquid and vapor phases for a binary system in vapor-liquid equilibrium using Raoult's law and Henry's law.
Achievement 11	Able to explain colligative properties and provide specific examples.	Able to explain colligative properties and provide specific examples.	Unable to explain colligative properties or provide specific examples.

Achievement 12	Able to explain quantities of state as well as differentiate between and provide examples of extensive and intensive properties. Able to express minute changes in state quantities using total derivatives.	Able to explain quantities of state as well as differentiate between and provide examples of extensive and intensive properties.	Unable to explain quantities of state or differentiate between and provide examples of extensive and intensive properties.
Achievement 13	Able to calculate the work associated with volume change and the heat associated with temperature change in reversible and irreversible processes.	Able to calculate the work associated with volume change and the heat associated with temperature change in reversible processes.	Unable to calculate the work associated with volume change or the heat associated with temperature change.
Achievement 14	Able to explain the first law of thermodynamics and express it mathematically. Able to explain the perpetual motion machine of the first kind.	Able to explain the first law of thermodynamics and express it mathematically.	Unable to explain the first law of thermodynamics or express it mathematically.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	This course focuses on the properties of gases and liquids. It aims to enable an understanding of the chemical and physical phenomena of gases and liquids at the molecular level by explaining these properties from the perspective of atoms and molecules.
Style	The class will progress through the use of textbooks and related handouts. Reports and quizzes may be assigned as needed to assess comprehension and facilitate the advancement of the class.
Notice	Much of the course content has been previously covered in Chemistry 1 and Chemistry 2. Instead of memorizing results, the emphasis is on understanding the reasons behind these phenomena.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
	1st Quarter	1st	Signifcant figures	
		2nd	Units and symbols	
		3rd	Perceiving substances and phenomena	
		4th	Basic terms (pressure, heat and heat capacity, work, energy)	
		5th	Three states of matter and the phase diagram	
		6th	Clausius–Clapeyron Formula	
		7th	Mid-term test	
		8th	Returning the mid-term test, providing answers and explanations	
1st				

1st Semester	2nd Quarter	9th	Ideal Gas and Various Laws of Ideal Gas (Boyle's law, Charles' law, Avogadro's Principle), Equation of State of Ideal Gas	
		10th	Ideal mixed gases and Dalton's law	
		11th	Kinetic theory of gas molecules	
		12th	Average velocity and velocity distribution of molecules (Maxwell-Boltzmann velocity distribution equation)	
		13th	Probability distribution functions (maximum probability rate, root mean square rate, average rate)	
		14th	Collision frequency and mean free path	
		15th	End-of-term test	
		16th	Returning the end-of-term test, providing answers and explanations	
2nd Semester	3rd Quarter	1st	Equation of state of real gas (van der Waals equation of state)	
		2nd	Critical point and van der Waals constant	
		3rd	State equation of real gases (virial equation of state)	
		4th	Vapor-liquid phase equilibrium in binary systems (Raoult's Law)	
		5th	Vapor-liquid phase equilibrium in binary systems (Henry's Law)	
		6th	Steam distillation	
		7th	Mid-term test	
		8th	Returning the mid-term test, providing answers and explanations	
	4th Quarter	9th	Colligative properties of solutions (vapor pressure drop, boiling point increase)	
		10th	Colligative properties of solutions (freezing point depression)	
		11th	Colligative properties of solutions (osmotic pressure)	
		12th	Terms used in thermodynamics: Systems, out of system, state quantities, state variables, work and heat	
		13th	Quasi-static processes: Work associated with change in volume	
		14th	First law of thermodynamics: Heat, work, internal energy	
		15th	End-of-term test	
		16th	Returning the end-of-term test, providing answers and explanations	

Evaluation Method and Weight (%)

	Examination	Quiz	Assignments	Total
Subtotal	80	10	10	100
Basic Proficiency	0	0	0	0
Specialized Proficiency	80	10	10	100
Cross Area Proficiency	0	0	0	0

Niihama College	Year	2023	Course Title	Physical Chemistry 2

Course Information			
Course Code	140461	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	PEL物理化学　福地賢治　編著（実教出版）		
Instructor			

Course Objectives

1. Explain systems, surroundings, and state quantities, and provide examples of extensive and intensive properties.
2. Calculate the work associated with volume changes and the heat associated with temperature changes.
3. Explain the First Law of Thermodynamics and express it using equations.
4. Calculate the internal energy change and enthalpy change associated with a state change.
5. Derive basic thermodynamic relationships.
6. Calculate the standard heat of reaction and the heat of reaction at any temperature for chemical reactions.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain state quantities, distinguish between extensive and intensive properties, and provide examples. Able to express the infinitesimal change of state quantities using total differentials.	Able to explain state quantities, distinguish between extensive and intensive properties, and provide examples.	Unable to explain state quantities, distinguish between extensive and intensive properties, or provide examples.
Achievement 2	Able to calculate the work associated with volume changes and the heat associated with temperature changes in reversible and irreversible processes.	Able to calculate the work associated with volume changes and the heat associated with temperature changes in reversible processes.	Unable to calculate the work associated with volume changes and the heat associated with temperature changes.
Achievement 3	Able to explain the First Law of Thermodynamics and express it using equations. Able to explain the concept by mentioning the perpetual motion machine of the first kind and giving examples.	Able to explain the First Law of Thermodynamics and express it using equations.	Unable to explain the First Law of Thermodynamics or express it using equations.
Achievement 4	Able to calculate the internal energy change and enthalpy change associated with temperature variations using the relationship between temperature and heat capacity.	Able to calculate the internal energy change and enthalpy change associated with temperature variations using the value of heat capacity that does not change with temperature.	Unable to calculate the internal energy change and enthalpy change associated with temperature variations using the value of heat capacity that does not change with temperature.

Achievement 5	Able to derive expressions for infinitesimal changes in internal energy and enthalpy and derive other related equations from the First Law of Thermodynamics and its definition.	Able to derive expressions for the infinitesimal changes in internal energy and enthalpy from the First Law of Thermodynamics and its definition.	Unable to derive expressions for the infinitesimal changes in internal energy and enthalpy from the First Law of Thermodynamics and its definition.
Achievement 6	Able to calculate the heat of reaction at any temperature using the standard heat of reaction, temperature, and heat capacity.	Able to calculate the heat of reaction at any temperature using the value of heat capacity that does not change with temperature and the standard heat of reaction.	Unable to calculate the heat of reaction at any temperature using the value of heat capacity that does not change with temperature and standard heat of reaction.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	The course covers the fundamental principles of thermodynamics, one of the pillars of physical chemistry. It focuses on the fundamental principle of the First Law of Thermodynamics and its application to chemistry. By applying this knowledge of thermodynamics, students will learn how to quantitatively explain the physical and chemical changes studied previously. The course includes explanations with diagrams and specific examples, as well as exercise problems to help students acquire the skills to understand and solve fundamental problems.
Style	The course will follow the printed materials distributed in each class. To ensure understanding of important points and concepts in each session, assignments will be given for each class. These assignments are intended to be submitted as reports to confirm the comprehension of the material.
Notice	This course is a two-credit-unit course with a total study time of 90 hours (including 30 hours of class time and 60 hours of self-study). To receive credit, a mandatory 60 hours of self-study is required, which includes assignments for self-study provided by the instructor, preparation and review time for classes, discussion time for exercise assignments to deepen understanding, and study time for exam preparation.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semeste	1st Quarter	1st	Terminology used in thermodynamics: System, surroundings, state quantities, state variables	1
		2nd	Work and heat	1
		3rd	Quasi-static process: work associated with volume change	1,2
		4th	First Law of Thermodynamics: Heat, work, and internal energy	1,2,3
		5th	Enthalpy: Constant pressure condition	1,2,3,4
		6th	Heat capacity: Constant pressure and constant volume conditions, Meyer's relation	1,2,3,4,5
		7th	Midterm test	1,2,3,4,5
		8th	Return of test and commentary	1,2,3,4,5

r	2nd Quarter	9th	Internal energy of an ideal gas (gas molecular kinetics)	4
		10th	Joule's law	4
		11th	Adiabatic change of an ideal gas: Poisson's equation	5
		12th	Standard enthalpy of formation	6
		13th	Standard enthalpy of reaction associated with chemical reaction	6
		14th	Enthalpy of reaction associated with chemical reaction at any temperature: Kirchhoff's formula	6
		15th	End-of-term test	1,2,3,4,5,6
		16th		

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Assignments	Total
Subtotal	70	0	0	0	0	30	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	70	0	0	0	0	30	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Physical Chemistry 3

Course Information			
Course Code	140462	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	PEL物理化学　福地賢治　編著（実教出版）		
Instructor			

Course Objectives

1. Explain the Second Law of Thermodynamics (Thomson's Principle, Clausius Theorem).
2. Explain the Carnot cycle and calculate its efficiency. Express the Second Law of Thermodynamics using entropy.
3. Calculate the entropy changes associated with volume changes, mixing, temperature changes, and phase transitions of ideal gases.
4. Explain the content of the Third Law of Thermodynamics and express it using equations.
5. Calculate the standard entropy change associated with chemical reactions and the entropy change at any temperature.
6. Use entropy, Gibbs energy, and Helmholtz energy to express equilibrium conditions.
7. Derive basic thermodynamic relationships.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the Second Law of Thermodynamics and the perpetual motion engine of the second kind.	Able to explain the Second Law of Thermodynamics.	Unable to explain the Second Law of Thermodynamics.
Achievement 2	Able to explain the Carnot cycle, derive the formula for efficiency, and perform calculations. Able to express the Second Law of Thermodynamics using entropy and provide explanations.	Able to explain the Carnot cycle and calculate the efficiency. Able to express the Second Law of Thermodynamics using entropy.	Unable to explain the Carnot cycle or express the Second Law of Thermodynamics using entropy.
Achievement 3	Able to derive equations and perform calculations for the entropy changes associated with volume changes, temperature changes, and phase transitions of an ideal gas. Able to calculate the entropy change associated with a mixture of ideal gases.	Able to calculate the entropy changes associated with volume changes and mixing, temperature changes, and phase transitions of an ideal gas.	Unable to calculate the entropy changes associated with volume changes and mixing, temperature changes, and phase transitions of an ideal gas.
Achievement 4	Able to explain the Third Law of Thermodynamics and express it using equations. Able to calculate residual entropy.	Able to explain the Third Law of Thermodynamics and express it using equations.	Unable to explain the Third Law of Thermodynamics or express it using equations.

Achievement 5	Able to calculate the entropy change at any temperature using the standard entropy change and the relationship between temperature and heat capacity.	Able to calculate the entropy change at any temperature using the standard entropy change and the value of heat capacity that does not change with temperature.	Unable to calculate the entropy change at any temperature using the standard entropy change and the value of heat capacity that does not change with temperature.
Achievement 6	Able to use entropy, Gibbs free energy, and Helmholtz free energy to express the direction of spontaneous changes and equilibrium conditions.	Able to use entropy, Gibbs free energy, and Helmholtz free energy to express equilibrium conditions.	Unable to use entropy, Gibbs free energy, and Helmholtz free energy to express equilibrium conditions.
Achievement 7	Able to derive expressions for infinitesimal changes in internal energy, enthalpy, Gibbs free energy, and Helmholtz free energy from the First and Second Laws of Thermodynamics and their defining equations, and to derive Maxwell's relations using these equations. Able to derive other equations, such as the Gibbs–Helmholtz equation, using these relations.	Able to derive expressions for infinitesimal changes in internal energy, enthalpy, Gibbs free energy, and Helmholtz free energy from the First and Second Laws of Thermodynamics and their defining equations, and to derive Maxwell's relations using these equations.	Unable to derive expressions for infinitesimal changes in internal energy, enthalpy, Gibbs free energy, and Helmholtz free energy from the First and Second Laws of Thermodynamics and their defining equations, or to derive Maxwell's relations using these equations.
Assigned Department Objectives			
Specialized Knowledge (B)			
Teaching Method			
Outline	The course covers the fundamental principles of thermodynamics, one of the pillars of physical chemistry, focusing on the First Law of Thermodynamics and its applications to chemistry. Through the use of thermodynamic principles, students will gain an understanding of how to quantitatively explain the physical and chemical changes studied thus far. The course employs explanations with diagrams, concrete examples, and problem-solving exercises to develop students' abilities to understand and solve fundamental problems.		
Style	The course will follow the printed materials distributed in each class. To ensure understanding of key points in each class, assignments will be given for the purpose of confirming comprehension. Students are required to submit reports based on these assignments for each class.		
Notice	This course is a two-credit-unit course with a total study time of 90 hours (including 30 hours of class time and 60 hours of self-study). To receive credit, a mandatory 60 hours of self-study is required, which includes assignments for self-study provided by the instructor, preparation and review time for classes, discussion time for exercise assignments to deepen understanding, and study time for exam preparation.		
Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
2nd Semester	3rd Quarter	1st	Second Law of Thermodynamics: Thomson's principle, Clausius theorem	1
		2nd	Heat engine and Carnot cycle, efficiency of Carnot cycle	2
		3rd	Second Law of Thermodynamics: Entropy	2
		4th	Entropy changes associated with state changes: Volume change of an ideal gas	3
		5th	Entropy changes associated with temperature change: Constant pressure condition and constant volume condition	3
		6th	Entropy changes associated with phase transitions Entropy changes associated with mixing: Mixing of ideal gases	3
		7th	Midterm test	1,2,3
		8th	Return of midterm test, commentary and answers	1,2,3
	4th Quarter	9th	Third Law of Thermodynamics: Nernst heat theorem and Planck's expression	4
		10th	Molecular theory interpretation of entropy: Boltzmann's expression	4
		11th	Standard entropy change associated with chemical reaction, entropy changes at any temperature	5
		12th	Entropy change of reversible and irreversible changes in adiabatic systems	6
		13th	Gibbs energy change for reversible and irreversible changes under isothermal and constant pressure conditions Helmholtz energy change for reversible and irreversible changes under isothermal and constant volume conditions	6
		14th	Thermodynamic relationships: Maxwell's equation and Gibbs–Helmholtz equation	7
		15th	End-of-term test	4,5,6,7
		16th	Return of end-of-term test, commentary and answers	4,5,6,7

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Quiz	Assignments	Total
Subtotal	80	0	0	0	10	10	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	80	0	0	0	10	10	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Biophysical Chemistry 1

Course Information

Course Code	140511	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	PEL物理化学　福地賢治　編著（実教出版）		
Instructor			

Course Objectives

1. Express the rate equation from a given elementary reaction and derive integrated rate equations for first- and second-order reactions.
2. Calculate half-life and rate constants from integrated rate equations.
3. Derive integrated rate equations for reversible and sequential reactions using formulas.
4. Derive the Michaelis-Menten equation using the steady-state approximation.
5. Calculate activation energy using the Arrhenius equation.
6. Understand the definition, classification, examples, and motion of colloids.
7. Explain the definition and characteristics of interfaces, as well as methods and calculations for measuring surface tension.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to express the rate equation from a given elementary reaction and derive the integrated rate equations for first- and second-order reactions (general type).	Able to express the rate equation from a given elementary reaction and derive the integrated rate equations for first- and second-order reactions (involving reactions between identical molecules only).	Unable to express the rate equation for a given elementary reaction.
Achievement 2	Able to use the integrated rate equation to calculate half-lives and rate constants.	Able to perform simple calculations for half-lives and rate constants using the integrated rate equation.	Unable to perform simple calculations for half-lives and rate constants using the integrated rate equation.
Achievement 3	Able to derive integrated rate equations for reversible and sequential reactions using formulas, as well as prove the formulas.	Able to derive integrated rate equations for reversible and sequential reactions using formulas.	Unable to derive integrated rate equations for reversible and sequential reactions using formulas.
Achievement 4	Able to derive the Michaelis–Menten equation using the steady-state approximation and explain the meaning of the equation.	Able to derive the Michaelis–Menten equation using the steady-state approximation.	Unable to derive the Michaelis-Menten equation using the steady-state approximation.

Achievement 5	Able to explain the Arrhenius equation and use it to calculate activation energy.	Able to calculate activation energy using the Arrhenius equation.	Unable to calculate activation energy using the Arrhenius equation.
Achievement 6	Able to sufficiently define and explain the classification, examples, and movements of colloids.	Able to define and explain the classification, examples, and movements of colloids.	Unable to define and explain the classification, examples, and movements of colloids.
Achievement 7	Able to sufficiently explain the definition and characteristics of interfaces, as well as measurement and calculation methods for surface tension.	Able to explain the definition and characteristics of interfaces, as well as measurement and calculation methods for surface tension.	Unable to explain the definition and characteristics of interfaces, as well as measurement and calculation methods for surface tension.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	Physical chemistry is broadly classified into two areas: equilibrium and kinetics. While this course primarily focuses on equilibrium, with a particular emphasis on chemical thermodynamics as studied in Physical Chemistry 2, it also encompasses kinetics. The study of kinetics imparts knowledge about reaction mechanisms, which may not be evident in equilibrium studies. Enzyme reactions are explored as specific examples. Additionally, the course provides an overview of interfaces and colloids, which are essential for understanding phenomena occurring in living organisms.
Style	Classes are conducted in accordance with handouts distributed for each lesson. To ensure comprehension of important points, assignments are given for each class, with students required to submit reports as a means of assessing their understanding.
Notice	In deriving the integral rate equation, solving differential equations is necessary. Therefore, students are advised to review methods such as separation of variables and solving first-order linear differential equations, as covered in the third-year mathematics classes (Mathematics A-3-1, Mathematics A-3-2). This course is structured as a unit credit course, offering 2 units, and entails a total study time of 90 hours, which includes 30 hours of class time and 60 hours of mandatory self-study. The self-study component encompasses assignments provided by the instructor, class preparation and review, contemplation time for exercise assignments to enhance understanding, and study time dedicated to exam preparation.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
	1st Quarter	1st	Guidance, reaction rate	1
		2nd	Formulation of reaction rate equations, reaction order	1
		3rd	Temperature-dependence of the reaction rate: Arrhenius equation	5
		4th	First- and zero-order reactions	1,2
		5th	Second-order reactions	1,2

1st Semester		6th	Pseudo-first-order reactions	1,2
		7th	Mid-term test	1,2,5
		8th	Solutions and explanations to the mid-term test	1,2,5
	2nd Quarter	9th	Parallel and reversible reactions	1,2,3
		10th	Sequential reactions, rate-limiting step approximation, steady-state approximation	1,2,3,4
		11th	Michaelis-Menton equation	1,2,3,4
		12th	Relationship between reaction and pressure	1
		13th	Definition, classification, and movement of colloids (Brownian motion sedimentation, viscosity, diffusion)	6
		14th	Definition of surface tension, methods to measure and calculate surface tension	7
		15th	End-of-term test	1,2,3,4,5,6,7
		16th		

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Quiz	Assignments	Total
Subtotal	70	0	0	0	0	30	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	70	0	0	0	0	30	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Biophysical Chemistry 2

Course Information

Course Code	140512	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	物理化学　福地賢治　編　（実教出版）		
Instructor			

Course Objectives

1. Express the conditions of equilibrium using Gibbs energy or chemical potential.
2. Demonstrate the relationship between standard Gibbs energy change and equilibrium constants.
3. Calculate the equilibrium constant of a reaction from thermodynamic data.
4. Use the van't Hoff equation to calculate the heat of reaction and equilibrium constants at any temperature.
5. Present the relationship between pressure changes and equilibrium constants, and be able to calculate equilibrium constants at any pressure.
6. State Gibbs' phase rule and calculate degrees of freedom.
7. Apply the Clausius–Clapeyron equation to gas–liquid equilibrium, solid–liquid equilibrium, and solid–gas equilibrium.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to logically explain the equilibrium conditions using Gibbs energy or chemical potential.	Able to express the equilibrium conditions using Gibbs energy or chemical potential.	Unable to express the equilibrium conditions using Gibbs energy or chemical potential.
Achievement 2	Able to derive the relationship between standard Gibbs energy changes and equilibrium constant.	Able to present the relationship between standard Gibbs energy changes and equilibrium constant.	Unable to present the relationship between standard Gibbs energy changes and equilibrium constant.
Achievement 3	Able to calculate the equilibrium constant of a reaction from thermodynamic data.	Able to calculate the equilibrium constant of a simple reaction from thermodynamic data.	Unable to calculate the equilibrium constant of a reaction from thermodynamic data.
Achievement 4	Able to calculate the heat of reaction or equilibrium constant at any temperature using the van't Hoff equation.	Able to calculate the heat of reaction for a simple reaction or equilibrium constant at any temperature using the van't Hoff equation.	Unable to calculate the heat of reaction or equilibrium constant at any temperature using the van't Hoff equation.

Achievement 5	Able to present the relationship between pressure changes and equilibrium constants and to calculate the equilibrium constant at any pressure.	Able to present the relationship between pressure changes and equilibrium constants, and to calculate the equilibrium constant at any pressure for a simple reaction.	Unable to present the relationship between pressure changes and equilibrium constants or calculate the equilibrium constant at any pressure.
Achievement 6	Able to derive the Gibbs phase rule and calculate the degrees of freedom.	Able to present the Gibbs phase rule and calculate the degrees of freedom.	Unable to present the Gibbs phase rule or calculate the degrees of freedom.
Achievement 7	Able to derive the Clausius–Clapeyron equation and apply it to gas–liquid equilibrium, solid–liquid equilibrium, and solid–gas equilibrium.	Able to apply the Clausius–Clapeyron equation to gas–liquid equilibrium, solid–liquid equilibrium, and solid–gas equilibrium.	Unable to apply the Clausius–Clapeyron equation to gas–liquid equilibrium, solid–liquid equilibrium, and solid–gas equilibrium.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	Through application of the thermodynamics studied in Physical Chemistry 2 in the fourth year, this course will cover the topics of chemical equilibrium and phase equilibrium with a focus on their relevance to chemistry and biochemistry. Understanding of Gibbs energy and Helmholtz energy will be applied to derive conditions for chemical equilibrium and phase equilibrium based on the chemical potential. Starting from these conditions, the course will demonstrate the thermodynamic validity of the mass action law and Le Chatelier's principle. Additionally, the course will delve into the thermodynamic understanding of phase equilibrium through the Clausius–Clapeyron equation and the Clapeyron equation.
Style	The teaching method involves a lecture format with active dialogue with the students. Additionally, exercises will be incorporated as needed.
Notice	This course is a two-credit-unit course with a total study time of 90 hours (including 30 hours of class time and 60 hours of self-study). To receive credit, a mandatory 60 hours of self-study is required, which includes assignments for self-study provided by the instructor, preparation and review time for classes, discussion time for exercise assignments to deepen understanding, and study time for exam preparation.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
		1st	Helmholtz energy and Gibbs energy	1
		2nd	Properties of Gibbs energy	1
		3rd	Thermodynamic equations: Maxwell's equation, Gibbs–Helmholtz equation	1

2nd Semester	3rd Quarter	4th	Properties of open systems and chemical potentials	1
		5th	Chemical potential of an ideal gas	1
		6th	Law of mass action: Relationship between standard Gibbs energy change and equilibrium constants	2,3,5
		7th	Midterm test	1
		8th	Calculation of standard Gibbs energy of formation and standard Gibbs energy changes in reactions: Exercises in the calculation of equilibrium constants and equilibrium compositions in the standard state	1
	4th Quarter	9th	Ideal solutions and ideal dilute solutions	4
		10th	Chemical potential of liquids: Ideal solutions, ideal dilute solutions and real solutions	4
		11th	Temperature changes of equilibrium constants: van't Hoff equation, Le Chatelier's principle	6
		12th	Method of calculation of equilibrium constants at any temperature and exercises in calculation	7
		13th	Derivation of Gibbs phase rule: Calculation of degrees of freedom	
		14th	Clapeyron's equation, Clapeyron–Clausius equation: Phase equilibrium	
		15th	End-of-term test	
		16th	Return of answers, commentary, and review	

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Assignments	Total
Subtotal	90	0	0	0	0	10	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	90	0	0	0	0	10	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Chemical Engineering 1

Course Information			
Course Code	140463	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	教科書　化学工学概論　小菅人慈　監修　（実教出版）／参考書　解説化学工学　竹内雍　他著　（培風館）・よくわかる化学工学　石井宏幸　他著　（森北出版）・化学系学生のための化学工学　森秀樹　他共編著　（培風館）・ベーシック化学工学　橋本健治　著　（化学同人）　など		
Instructor			

Course Objectives

1. Able to convert units to SI units.
2. Able to calculate mass balance when material flow and chemical reactions are involved.
3. Able to calculate the pipe diameter, flow velocity, flow rate, and Reynolds number, and judge the state of flow.
4. Able to calculate the flow energy balance, energy loss, and power of fluid transport.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to convert units to SI units, and able to apply to calculations of physical properties, etc.	Able to convert units to SI units.	Unable to convert units to SI units.
Achievement 2	Able to calculate mass balance of system consisting of multiple devices multiple devices when material flow and chemical reactions are involved.	Able to calculate mass balance for material flow and chemical reactions are involved.	Unable to calculate mass balance when material flow and chemical reactions are involved.
Achievement 3	Able to calculate the average flow velocity, flow rate, and Reynolds number, judge the state of flow, and explain Newtonian fluid.	Able to calculate the average flow velocity, flow rate, and Reynolds number, and judge the state of flow.	Unable to calculate the average flow velocity, flow rate, and Reynolds number, and unable to judge the state of flow.
Achievement 4	Able to calculate flow energy balance, energy loss in joints and non-circular cross-section channels, and power of fluid transport.	Able to calculate flow energy balance, energy loss, and power of fluid transport.	Unable to calculate flow energy balance, energy loss, and power of fluid transport.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	Master handling of units that form the basis of stoichiometric calculations and acquire quantitative handling of processes through exercises in mass balance calculations. In addition, learn about flow operations and acquire basic knowledge on equipment and process design and analysis. Chemical engineering involves learning about operations to realize the production of chemical products industrially, and comprises skills that must be acquired as a practical engineer. Particularly, this is a core course in chemical engineering to learn about the handling of fluids related to all chemical industry operations, along with mastering the most basic balance calculations.
Style	Classes will be conducted based on preparation materials to be disclosed before class and handouts to be distributed during class. Exercises will be conducted on related topics by explaining the contents of the preparation materials and distributed handouts during class. When working on exercises, it is desirable to bring a scientific calculator. Practice assignments that are not completed during class should be completed by the next week as it will be a self-study assignment.
Notice	Basic knowledge of mathematics, physics, and chemistry is required to understand this course. The content is linked to physical chemistry, and serves as the foundation for Chemical Engineering 2, 3, and 4. This course is an academic credit course (2 credits), and the total study time is 90 hours. (The breakdown is 30 hours of class time and 60 hours of self-study time.) Self-study equivalent to 60 hours is necessary for credit approval, and this self-study time shall include self-study assignments from the faculty in charge, preparation review time for classes, discussion time for practice assignments to deepen understanding, and learning time for exam preparation.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	2nd Quarter	1st	Introduction: What is chemical engineering? Units: International System of Units	
		2nd	Units: Unit conversion	
		3rd	Mass balance: Mass balance without chemical reactions 1	
		4th	Mass balance: Mass balance without chemical reactions 2	
		5th	Mass balance: Mass balance involving chemical reactions 1	
		6th	Mass balance: Mass balance involving chemical reactions 2	
		7th	Midterm examination	
		8th	Exam results, Flow: Mass balance of flow	

	2nd Quarter	9th	Flow: Energy balance of flow	
		10th	Flow: State of flow and Reynolds number	
		11th	Flow: Friction loss of fluid in laminar flow	
		12th	Flow: Friction loss of fluid in turbulent flow	
		13th	Flow: Power of fluid transport	
		14th	Flow: Flowmeters and fluid transport devices	
		15th	Final examination	
		16th	Exam results, Conclusion	

Evaluation Method and Weight (%)

	Examination	Assignments	Total
Subtotal	80	20	0
Basic Proficiency	0	0	0
Specialized Proficiency	80	20	0
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Chemical Engineering 2

Course Information

Course Code	140464	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	科書　化学工学概論　小菅人慈　監修　（実教出版）／参考書　解説化学工学　竹内雍　他著　（培風館）・よくわかる化学工学　石井宏幸　他著　（森北出版）・化学系学生のための化学工学　森秀樹　他共編著　（培風館）・ベーシック化学工学　橋本健治　著　（化学同人）　など		
Instructor			

Course Objectives

1. Able to explain the rate of heat transfer due to thermal conduction.
2. Able to explain the structure of a heat exchanger, heat balance, and heat transfer rate within a heat exchanger.
3. Able to explain radiant heat transfer.
4. Able to explain evaporation equipment, and calculate the mass balance and heat balance of the evaporator.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to calculate the rate of heat transfer due to thermal conduction.	Able to explain the rate of heat transfer due to thermal conduction.	Unable to explain the rate of heat transfer due to thermal conduction.
Achievement 2	Able to explain the structure of a heat exchanger, and calculate the heat balance, and heat transfer rate within a heat exchanger.	Able to explain the structure of a heat exchanger, heat balance, and heat transfer rate within a heat exchanger.	Unable to explain the structure of a heat exchanger, heat balance, and heat transfer rate within a heat exchanger.
Achievement 3	Able to explain radiant heat transfer and perform simple system calculations.	Able to explain radiant heat transfer.	Unable to explain radiant heat transfer.
Achievement 4	Able to explain evaporation equipment, and calculate the mass balance and heat balance of the evaporator.	Able to explain evaporation equipment, and calculate the mass balance and heat balance of the evaporator.	Able to explain evaporation equipment, but unable to calculate the mass balance and heat balance of the evaporator.

Assigned Department Objectives

Specialized Knowledge (B)

Teaching Method

Outline	Learn about heat transfer operations and acquire basic knowledge on equipment and process design and analysis. Chemical engineering involves learning about operations to realize the production of chemical products industrially, and comprises skills that must be acquired as a practical engineer. This is a core course of chemical engineering to learn about the handling of heat related to all chemical industry operations.
Style	Classes will be conducted based on preparation materials to be disclosed before class and handouts to be distributed during class. Exercises will be conduced on related matters by explaining the contents of preparation materials and distributed handouts during class. When working on exercises, it is desirable to bring a scientific calculator. Practice assignments that are not completed during class should be completed by the next week as it will be a self-study assignment.
Notice	Basic knowledge of mathematics, physics, and chemistry is required to understand this course. The content is linked to physical chemistry, and serves as the foundation for Chemical Engineering 3 and 4. This course is an academic credit course (2 credits), and the total study time is 90 hours. (The breakdown is 30 hours of class time and 60 hours of self-study time.) Self-study equivalent to 60 hours is necessary for credit approval, and this self-study time shall include self-study assignments from the faculty in charge, preparation review time for classes, discussion time for practice assignments to deepen understanding, and learning time for exam preparation.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Heat transfer: Fundamentals of heat treatment, Fourier's law	1
		2nd	Heat transfer: Heat conduction in planar walls and multi-planar walls	1
		3rd	Heat transfer: Heat conduction in cylindrical walls and multi-cylindrical walls	1
		4th	Heat transfer: Heat transmission and heat transfer coefficient	2
		5th	Heat transfer: Heat exchanger	2
		6th	Heat transfer: Heat balance and design of double tube heat exchanger	2
		7th	Midterm examination	
		8th	Exam results, Heat transfer: Empirical formula for film heat transfer coefficient	2
	4th Quarter	9th	Heat transfer: Radiant heat transfer between two objects	3
		10th	Heat transfer: Combined heat transfer of convection and radiation	3
		11th	Heat transfer: Evaporation operation and elevation of boiling point	4
		12th	Heat transfer: Mass balance and heat balance of evaporator ①	4
		13th	Heat transfer: Mass balance and heat balance of evaporator ②	4
		14th	Heat transfer: Design of evaporator	4

		15th	Final examination	
		16th	Exam results, Conclusion	

Evaluation Method and Weight (%)

	Examination	Assignments	Total
Subtotal	80	20	0
Basic Proficiency	0	0	0
Specialized Proficiency	80	20	0
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Biochemistry 1

Course Information

Course Code	140307	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	マクマリー生物有機化学［生化学編］ 原書8版 単行本（ソフトカバー） – 2018/1/9、配布プリント		
Instructor			

Course Objectives

1. Ability to provide a basic explanation of biomolecules including carbohydrates (sugar), proteins, lipids, nucleic acids, vitamins, and minerals.
2. Ability to explain different types of metabolism (glycolysis, TCA cycle, electron transport chain, ornithine cycle, etc.).
3. Ability to explain about the main organs involved in the digestion/absorption and metabolism of nutrients, namely the stomach, intestines, pancreas, liver, gallbladder, and spleen.
4. Ability to explain important enzymatic reactions.
5. Ability to explain the mechanism of homeostasis maintenance via metabolism control in an organism, such as the regulation of blood sugar level by hormones and nerves.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain representative examples of fundamental biomolecules in detail by writing chemical formulae.	Able to provide basic explanations of fundamental biomolecules.	Unable to provide basic explanations for fundamental biomolecules.
Achievement 2	Able to specifically explain different types of metabolism (glycolysis, TCA cycle, electron transport chain, ornithine cycle, etc.) along with illustrations.	Able to explain different types of metabolism (glycolysis, TCA cycle, electron transport chain, ornithine cycle, etc.).	Unable to explain different types of metabolism (glycolysis, TCA cycle, electron transport chain, ornithine cycle, etc.).
Achievement 3	Able to explain the outline of the functions of the stomach, intestines, pancreas, liver, gallbladder, and spleen with a clear reference to related compounds.	Able to explain the outline of the functions of the stomach, intestines, pancreas, liver, gallbladder, and spleen.	Unable to explain the outline of the functions of the stomach, intestines, pancreas, liver, gallbladder, and spleen.

Achievement 4	Able to specifically explain several important enzymatic reactions using illustrations, etc.	Able to explain the outline of several important enzymatic reactions in words.	Unable to explain the outline of several important enzymatic reactions in words.
Achievement 5	Able to explain in detail the mechanism of homeostasis maintenance via metabolism control in an organism, such as the regulation of blood sugar level by hormones and nerves.	Able to explain the outline of the mechanism of homeostasis maintenance via metabolism control in an organism, such as the regulation of blood sugar level by hormones and nerves.	Unable to explain the mechanism of homeostasis maintenance via metabolism control in the organism, such as the regulation of blood sugar level by hormones and nerves.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	Learn the structure and properties of substances that make up an organism and their flow in the organism, such as "breakdown → absorption → utilization → excretion" of substances incorporated into the body, in this course. The purpose of learning about these substances is to be able to imagine the types of phenomena occurring in our body.
Style	Classes will be basically conducted in a lecture format and evaluated through periodic tests, quizzes, presentations, etc.
Notice	Be sure to revise the previous lesson to be able to attempt the quiz conducted at the beginning of the class. Although it is a course with a lot of content to remember, there are many topics related to certain words and phrases that are related to your own body and what you hear in everyday life; therefore, it is desirable to remember these while associating with everyday things rather than simple memorizing.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semest	1st Quarter	1st	Guidance, carbohydrates	1
		2nd	Proteins ① (amino acid)	1
		3rd	Proteins ② (peptide bond)	1
		4th	Lipids	1
		5th	Role of vitamins	1,4
		6th	Digestion ① (functions of the stomach and small intestine in digestion and absorption)	3
		7th	Midterm examination	1,3,4
		8th	Digestion ② (functions of the liver, pancreas, and gallbladder)	3,4

e r	2nd Quarter	9th	Metabolism ① (glycolysis, TCA cycle, electron transport chain)	2
		10th	Metabolism ② (ornithine cycle, etc.)	2
		11th	Homeostasis in living organisms ① (autonomic nervous system and hormones)	5
		12th	Homeostasis in living organisms ② (blood sugar level, thermoregulation, etc.)	5
		13th	Genetic material	3
		14th	Role of minerals	1
		15th	Final examination	2,3,4,5
		16th		

Evaluation Method and Weight (%)

	Examination	Quiz	Assignments	Total
Subtotal	70	20	10	100
Basic Proficiency	20	5	0	25
Specialized Proficiency	40	15	10	65
Cross Area Proficiency	10	0	0	10

Niihama College	Year	2023	Course Title	Biochemistry 2

Course Information

Course Code	140425	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	【教科書】マクマリー生物有機化学［生化学編］ 原書8版　菅原 二三男・倉持 幸司（監修、翻訳）（丸善出版）、【参考書】コーン・スタンプ生化学　田宮信雄・八木達彦　訳（東京化学同人）、生化学辞典　今堀和友・山川民夫　監修（東京化学同人）、分子細胞生物学　G.Karp　著　山本正幸・渡辺雄一郎　監訳（東京化学同人）		
Instructor			

Course Objectives

1. Ability to explain weak interactions between molecules
2. Ability to explain electron configuration and the structures and properties of water and oxygen molecules
3. Ability to explain the resonance structures of nucleobases and peptide bonds
4. Ability to explain the acid-base dissociation equilibrium of biomolecules
5. Ability to explain high-energy compounds such as ATP
6. Ability to explain the structures and functions of lipid molecules, especially the formation of molecular assemblies
7. Ability to explain the basic constituent substances and functions of cells
8. Ability to explain the structures and functions of intracellular organelles such as nucleus and chromosomes, endoplasmic reticulum, Golgi bodies, mitochondria, chloroplasts, etc.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain weak interactions between molecules based on a physicochemical understanding	Able to explain the outline of weak interactions between molecules	Unable to explain the outline of weak interactions between molecules
Achievement 2	Able to explain the relationship between electron configuration and the structure/properties of water and oxygen molecules based on a quantum-chemical understanding	Able to explain the outline of the relationship between electron configuration and the structure/properties of water and oxygen molecules	Unable to explain the outline of the relationship between electron configuration and the structure/properties of water and oxygen molecules
Achievement 3	Able to explain the resonance structures of nucleobases and peptide bonds based on an understanding of the concept of molecular orbitals	Able to explain the resonance structures of nucleobases and peptide bonds	Unable to explain the resonance structures of nucleobases and peptide bonds
Achievement 4	Able to explain the acid-base dissociation equilibrium of biomolecules along with the concept of pKa of substances	Able to explain the acid-base dissociation equilibrium of biomolecules	Unable to explain the acid-base dissociation equilibrium of biomolecules

Achievement 5	Able to explain high-energy compounds such as ATP using the concept of free energy change	Able to explain the outline of high-energy compounds such as ATP	Unable to explain the outline of high-energy compounds such as ATP
Achievement 6	Able to explain the structure and functions of lipid molecules, especially the formation of molecular assemblies, based on an understanding of the concept of hydrophobic interactions	Able to explain the structure and functions of lipid molecules, especially the formation of molecular assemblies	Unable to explain the structure and functions of lipid molecules, especially the formation of molecular assemblies
Achievement 7	Able to explain the basic constituent substances and functions of cells along with a mention of molecular structure and functions	Able to explain the basic constituent substances and functions of cells	Unable to explain the basic constituent substances and functions of cells
Achievement 8	Able to explain the structure and functions of intracellular organelles and discuss molecular mechanisms	Able to explain the outline of the structure and functions of intracellular organelles	Unable to explain the outline of the structure and functions of intracellular organelles

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	First, to be able to logically understand the relationship between the structure and physical properties of the organic compounds that make up living organisms. For this reason, the lecture will be from a somewhat basic theoretical perspective. Second, to learn about the chemistry of lipids, which are the main components of biomembrane components. Third, to deepen the understanding of the structure and role of intracellular organelles, especially the mechanism of energy metabolism.
Style	Classes will be conducted in a lecture format based on textbooks and handouts.
Notice	This is a basic lecture to better understand the function of cells, which are the basis of life, at the molecular level. Some topics may seem to be slightly difficult at this stage, but the aim is to encourage you to think deeply about the topics yourself. In addition to understanding well the contents of Biochemistry 1, be sure to learn Organic Chemistry 1 and 2 and Physical Chemistry 1 as well.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
		1st	Review and verification of Organic Chemistry 1 and Biochemistry 1	
		2nd	Water structure and life and weak interactions between biomolecules	
		3rd	Organic molecules and conjugated systems (to better understand biomolecules)	

1st Semester	1st Quarter	4th	Nucleic acids, nucleotide coenzymes, amino acids and proteins, and hormones (discussion on topics including "environmental" hormones)	
		5th	Chemistry and biochemistry of porphyrins, iron－sulfur clusters, etc.	
		6th	Acidic and basic properties of biomolecules	
		7th	Midterm examination	
		8th	Cells and biomembranes	
	2nd Quarter	9th	Chemistry and biochemistry of lipids	
		10th	Cells 1: Nutrient absorption, cell division, and proliferation	
		11th	Cells 2: Structure and Functions 1: Eukaryotic cells, actin, and tubulin	
		12th	Cells 3: Structure and Functions 2: Nuclei and chromosomes	
		13th	Cells 4: Structure and Functions 3: Synthesis and degradation system of proteins	
		14th	Cells 5: Organism and Energy: Functions of mitochondria	
		15th	Final examination	
		16th		

Evaluation Method and Weight (%)

	Examination	Assignments	Other	Total
Subtotal	70	30	0	100
Basic Proficiency	0	0	0	0
Specialized Proficiency	70	30	0	100
Cross Area Proficiency	0	0	0	0

Niihama College	Year	2023	Course Title	Analytical Chemistry

Course Information

Course Code	140306	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	基礎 分析化学　[新訂版]　　宗林 由樹・向井　浩　共著　　（サイエンス社）		
Instructor			

Course Objectives

1. Understand the concept of moles.
2. Be able to perform concentration calculations, such as molar concentration and mole fraction.
3. Understand the concept of homogeneous equilibrium and be able to apply the law of mass action.
4. Understand the concept of pH and be able to perform pH calculations.
5. Understand various equilibrium constants (ion product of water, dissociation constants, solubility product, etc.) and be able to perform calculations using these constants.
6. Understand the concept of redox equilibrium and be able to apply it to electrolysis reactions and electrode reactions.
7. Understand various titrations (neutralization, precipitation, redox, and chelation) and be able to perform quantitative calculations.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to calculate substance quantity (moles) using the atomic weight table. Able to understand the layout of the periodic table and grasp the relationship between valency of substances and equivalents of an element, and perform calculations based on this understanding.	Able to calculate substance quantity (moles) using the atomic weight table. Able to calculate the equivalents of an element from the periodic table of elements.	Unable to calculate substance quantity (moles) using the atomic weight table. Unable to calculate the equivalents of an element from the periodic table of elements.
Achievement 2	Able to calculate concentrations such as molar concentration and mole fractions. Able to convert between mass percent concentration and molar concentration using density (specific gravity). Able to calculate mass molality.	Able to calculate concentrations such as molar concentration and mole fractions.	Unable to calculate concentrations such as molar concentration and mole fractions.

Achievement 3	Able to explain the relationship between the dissociation constant (K), ionization degree (α), and concentration (C), and calculate them.	Able to calculate the concentrations of weak acids and bases using the relationship between the dissociation constant (K), ionization degree (α), and concentration (C).	Unable to calculate the concentrations of weak acids and bases using the relationship between the dissociation constant (K), ionization degree (α), and concentration (C).
Achievement 4	Able to calculate the pH of solutions containing monoprotic acids or bases as well as their salts. Also able to calculate the pH of solutions containing polyprotic acids, bases, or salts.	Able to calculate the pH of solutions containing monoprotic acids or bases as well as their salts.	Unable to calculate the pH of solutions containing monoprotic acids, bases, or their salts.
Achievement 5	Able to calculate the pH of solutions containing monoprotic acids or bases as well as their salts. Also able to calculate the pH of solutions containing polyprotic acids, bases, or salts. Able to understand various equilibrium constants, such as the ion product of water, dissociation constants, and solubility product constants, and perform calculations using these constants. In particular, he/she is able to explain the influence of pH on the solubility of sparingly soluble salts.	Able to understand various equilibrium constants, such as the ion product of water, dissociation constants, and solubility product constants, and perform calculations using these constants.	Unable to understand various equilibrium constants, such as the ion product of water, dissociation constants, and solubility product constants, or perform calculations using these constants.
Achievement 6	Able to explain the concept of oxidation numbers and perform calculations for redox titrations. Able to explain the electrode reactions at the anode and cathode in electrolysis and perform calculations using Faraday's laws in series and parallel electrolysis cells.	Able to explain the concept of oxidation numbers and perform calculations for redox titrations. Able to perform calculations using Faraday's law in electrolysis.	Unable to explain the concept of oxidation numbers and perform calculations for redox titrations. Furthermore, he/she is unable to perform calculations using Faraday's law in electrolysis.

Achievement 7	Able to understand various titrations (neutralization, precipitation, redox, and chelation) and perform quantitative calculations. Additionally, they are able to explain the general shapes of titration curves for each type of titration and describe the selection of appropriate indicators.	Able to understand various titrations (neutralization, precipitation, redox, and chelation) and perform quantitative calculations.	Unable to understand various titrations (neutralization, precipitation, redox, and chelation) and perform quantitative calculations.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	Building on a solid understanding of the fundamentals of chemistry, such as moles and concentration, the course aims to grasp the concept of chemical equilibrium. It covers homogeneous equilibria using acids, bases, and oxidation–reduction reactions as examples, while also addressing heterogeneous equilibria with a focus on solid–liquid equilibria. By incorporating content from the analytical chemistry experiments performed in the second year, the goal is to deepen the theoretical understanding of quantitative analysis.
Style	The classes will follow the textbook, and handouts will be distributed to students. Exercises will be assigned periodically to confirm the understanding of key concepts and the overall comprehension of the subject matter.
Notice	It is essential to thoroughly master the foundational knowledge learned in Chemistry 1 and 2, such as chemical formulas, moles, concentration calculations, understanding the periodic table, etc., either in advance or at the beginning of the course. Students are strongly advised to engage in self-study to fill any gaps in their understanding.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Notations of atomic weight, molecular weight, moles, concentration	1,2
		2nd	Acids, bases, and salts	2
		3rd	Chemical equilibrium and dissociation constant	2,3
		4th	pH of strong acids and strong bases	4
		5th	pH and ionization of weak acids and bases	4
		6th	Review and exercises of the scope of course content covered by the test	1,2,3,4
		7th	Midterm test	
		8th	Return of test and commentary	
		9th	pH of weak acids and weak base salts	4
		10th	Buffer solutions	4
		11th	pH of polybasic acids	4

	2nd Quarter	12th	Neutralization titration: Titration curve	7
		13th	Neutralization titration: Differentiating titration	7
		14th	Review and exercises of the scope of course content covered by the test	1,2,3,4,7
		15th	End-of-term test	
		16th	Return of test and commentary	
2nd Semester	3rd Quarter	1st	Complex reactions	3,5
		2nd	Chelate titrations	7
		3rd	Solubility and solubility product of insoluble salts	5
		4th	Influence of pH on solubility	5
		5th	Precipitation titration	7
		6th	Review and exercises of the scope of course content covered by the test	3,5,7
		7th	Midterm test	
		8th	Return of test and commentary	
	4th Quarter	9th	Oxidation number, redox reactions	6
		10th	Electrode reactions and batteries	6
		11th	Redox potentials	6
		12th	Nernst equation	5,6
		13th	Redox titration	6,7
		14th	Review and exercises of the scope of course content covered by the test	5,6,7
		15th	End-of-term test	
		16th	Return of test and commentary	

Evaluation Method and Weight (%)

	Examination	Assignments	Other	Total
Subtotal	70	30	0	100
Basic Proficiency	30	20	0	50
Specialized Proficiency	40	10	0	50
Cross Area Proficiency	0	0	0	0

Niihama College	Year	2023	Course Title	Instrumental Analysis

Course Information			
Course Code	140469	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	入門機器分析化学　庄野利之、脇田久伸　編著　（三共出版）		
Instructor			

Course Objectives

1. Understand the principles of absorbance analysis (derivation of Beer–Lambert law).
2. Understand the principles of chromatography, including classification.
3. Understand the principles of infrared absorption spectroscopy and infer functional groups from characteristic absorptions.
4. Understand the principles of thermal analysis (TG, DTA, and DSC).
5. Understand nuclear magnetic resonance (NMR) and have the capability to analyze structures based on chemical shifts.
6. Understand the principles of atomic absorption spectroscopy.
7. Understand the principles of mass spectrometry.
8. Understand the principles of scanning electron microscopy and X-ray photoelectron spectroscopy.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the principle of light absorption and derive the formula for the Beer–Lambert law from transmittance and absorbance, as well as perform calculations using this formula.	Able to perform calculations using the formula for the Beer–Lambert law.	Unable to perform calculations using the formula for the Beer–Lambert law.
Achievement 2	Able to understand the principles of chromatography and classify techniques.	Able to provide a summary of chromatography.	Unable to provide a summary of chromatography.
Achievement 3	Able to understand the principles of infrared spectroscopy and infer functional groups from characteristic absorption patterns.	Able to infer functional groups from characteristic absorption patterns in infrared spectroscopy analysis.	Unable to infer functional groups from characteristic absorption patterns in infrared spectroscopy analysis.

Achievement 4	Able to understand the principles of thermal analysis (TG, DTA, and DSC). Able to infer thermal reactions and thermal transformation processes from the results of measurement.	Able to understand the principles of thermal analysis (TG, DTA, and DSC).	Unable to understand the principles of thermal analysis (TG, DTA, DSC).
Achievement 5	Able to understand nuclear magnetic resonance and analyze structures based on chemical shifts.	Able to analyze structures based on chemical shifts in NMR.	Unable to analyze structures based on chemical shifts in NMR.
Achievement 6	Able to understand the principles of atomic absorption spectrometry. Able to quantify analyte elements from the results of atomic absorption spectrometry measurements.	Able to understand the principles of atomic absorption spectrometry.	Unable to understand the principles of atomic absorption spectrometry.
Achievement 7	Able to understand the principles of mass spectrometry. Able to determine molecular weight and quantify trace components from the results of measurements.	Able to understand the principles of mass spectrometry.	Unable to understand the principles of mass spectrometry.
Achievement 8	Able to understand the principles of scanning electron microscopes and X-ray photoelectron spectroscopy and the results obtained from these analyses.	Able to understand the principles of scanning electron microscopes and X-ray photoelectron spectroscopy.	Unable to understand the principles of scanning electron microscopes and X-ray photoelectron spectroscopy.
Assigned Department Objectives			
Specialized Knowledge (B)			
Teaching Method			
Outline	This course explains various instrumental analysis methods, focusing particularly on the theory and principles of each method. The emphasis is placed on understanding the theories and principles.		
Style	Before the various instrumental analysis methods are explained, students are given handouts to help them review foundational knowledge (physics, chemistry, etc.). Additionally, after the explanations, they will be provided with exercise handouts to check their understanding of theory and principles. The lectures are conducted concurrently with instrumental analysis experiments with the goal of enhancing the comprehension of the subject matter.		

Notice	Instrumental Analysis Chemistry is a highly important discipline that underpins modern scientific industries. Such instrumentation is widely encountered, especially by those employed in chemical-related companies. It is crucial for students to understand the principles of instruments based on a foundation in physics, mathematics, and chemistry.

Characteristics of Class / Division in Learning			
□ Active Learning	□ Aided by ICT	□ Applicable to Remote Class	□ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Relationship between the properties of light (waves, particles), energy, and wavelength	1
		2nd	Principles of absorbance analysis (Beer–Lambert law)	1
		3rd	Overview of the absorption spectrophotometer and its use in analysis	1
		4th	Fundamentals of chromatography	2
		5th	Qualitative analysis and quantitative analysis by chromatography	2
		6th	Types of chromatography and the instrumentation used in each	2
		7th	Midterm test	
		8th	Return of test, summary of lesson content and confirmation	
	2nd Quarter	9th	Overview of infrared spectroscopy	3
		10th	Molecular vibrations in infrared spectroscopy	3
		11th	Characteristic absorptions in infrared absorption	3
		12th	Overview of thermal analysis	4
		13th	Analysis of the results of thermal analysis (1)	4
		14th	Analysis of the results of thermal analysis (2)	4
		15th	End-of-term test	
		16th	Return of test, summary of lesson content and confirmation	
	3rd Quarter	1st	Fundamentals of nuclear magnetic resonance (NMR)	5
		2nd	Chemical shifts in NMR	5
		3rd	Exercises in NMR (1)	5
		4th	Exercises in NMR (2)	5
		5th	Principles of atomic absorption spectrometry	6
		6th	Flame analysis and emission spectrometry	6
		7th	Midterm test	

2nd Semester		8th	Return of test, summary of lesson content and confirmation	
	4th Quarter	9th	Overview and application of mass spectrometry	7
		10th	Analysis of mass spectrometry results (1)	7
		11th	Analysis of mass spectrometry results (2)	7
		12th	Overview of surface analysis	8
		13th	Electron microscopy (SEM, TEM)	8
		14th	X-ray and X-ray photoelectron spectroscopy (XPS)	8
		15th	End-of-term test	
		16th	Return of test, summary of lesson content and confirmation	

Evaluation Method and Weight (%)

	Examination	Presentation	Assignments	Behavior	Portfolio	Other	Total
Subtotal	70	0	30	0	0	0	100
Basic Proficiency	30	0	10	0	0	0	40
Specialized Proficiency	40	0	20	0	0	0	60
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Intellectual Property

Course Information			
Course Code	140515	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	配布プリント		
Instructor			

Course Objectives

1. Understand and acquire the capacity to explain the basics of industrial property rights (i.e., patents, utility model law, design law, trademark law), copyright law, seed law, unfair competition prevention law, antitrust law, and intellectual property rights conventions.
2. Understand and acquire the capacity to explain the basic idea linkages with patent applications.
3. Understand and acquire the capacity to explain the fundamentals of intellectual property, including inventions and designs related to content originating in specific regions.
4. Learn the basics of patent specifications and develop the ability to create a simple patent specification.
5. Understand and acquire the capacity to explain the basics of intellectual property with reference to issues in familiar cases.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Understands and can explain the basics of industrial property rights (i.e., patents, utility model law, design law, trademark law), copyright law, seed law, unfair competition prevention law, antitrust law, and intellectual property rights conventions	Understands the basics of industrial property rights (i.e., patents, utility model law, design law, trademark law), copyright law, seed law, unfair competition prevention law, antitrust law, and intellectual property rights conventions	Does not understand the basics of industrial property rights (i.e., patents, utility model law, design law, trademark law), copyright law, seed law, unfair competition prevention law, antitrust law, and intellectual property rights conventions
Achievement 2	Understands and can explain basic idea linkages with patent applications	Understands basic idea linkages with patent applications	Does not understand basic idea linkages with patent applications
Achievement 3	Understands and can explain the fundamentals of intellectual property, including inventions and designs related to content originating in specific regions	Understands the fundamentals of intellectual property, including inventions and designs related to content originating in specific regions	Does not understand the fundamentals of intellectual property, including inventions and designs related to content originating in specific regions

Achievement 4	Understands the basics of patent specifications and can create simple patent specifications	Understands the basics of patent specifications	Does not understand the basics of patent specifications
Achievement 5	Understands and can explain the basics of intellectual property with reference to issues in familiar cases	Understands the basics of intellectual property with reference to issues in familiar cases	Does not understand the basics of intellectual property with reference to issues in familiar cases

Assigned Department Objectives	
Specialized Knowledge (B), Communication Skill (E)	
Teaching Method	
Outline	In this course, students will, through practical exercises, learn about intellectual property in detail, at the Intellectual Property Management Skills Test Level 3 (e.g., identification and resolution of problems that may arise regarding inventions and designs and legal knowledge of trademarks and copyrights). Students will learn how to link ideas to patent applications by focusing on local content and issues in familiar case studies. Students will, in groups and independently, develop their ideas into 3- and 1- minute pitches, respectively. Additionally, students will learn to draft a simple patent specification.
Style	Classes will follow the content provided in the distributed handouts. In-class assignments will be given to review the importance and understanding of each topic, and students will be required to submit reports. Review tests will be conducted as required.
Notice	This course is a 2-credit course that totals 90 hours of study (breakdown: 30 hours of class study, 60 hours of self-study). Self-study time includes independent tasks assigned by the teacher, lesson review and preparation time, reflection time to contemplate exercises and deepen understanding, and exam preparation study time.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semest	1st Quarter	1st	Guidance (explanation of class format)	1,2,3,4,5
		2nd	Patent law, utility model law	1
		3rd	Trademark law, design law	1
		4th	Copyright law, seed law, unfair competition prevention law, antitrust law, treaties	1
		5th	Invention and Patenting 1	2
		6th	3-minute group pitch (on intellectual property originating in a specific region)	3
		7th	Mid-term exams	1
		8th	Patent specifications	4

er	2nd Quarter	9th	Academic papers and patent specifications	4
		10th	Drafting Patent Specifications 1	4
		11th	Drafting Patent Specifications 2	4
		12th	Drafting Patent Specifications 3	4
		13th	Part Ⅰ – 1-minute individual pitch (on intellectual property)	5
		14th	Part Ⅱ – 1-minute individual pitch (on intellectual property)	5
		15th	Final exam	4
		16th	Invention and Patenting 2	2

Evaluation Method and Weight (%)

	Examination	Assignments	Quiz	Total
Subtotal	50	40	10	100
Basic Proficiency	0	10	5	15
Specialized Proficiency	50	20	5	75
Cross Area Proficiency	0	10	0	10

Niihama College	Year	2023	Course Title	Management in Engineering

Course Information			
Course Code	140506	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Developing basic knowledge of what a company is
2. Understanding the basics of IP strategy and commercial law in a company
3. Learning the basics of quality control and health and safety management

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can explain the image and code of conduct of engineers as required by companies, as well as their necessity.	Can explain the image and code of conduct of engineers as required by companies.	Cannot explain the image and code of conduct of engineers as required by companies.
Achievement 2	Can explain the items related to IP strategy and technology management in a company, as well as their necessity.	Can list the items related to IP strategy and technology management in a company.	Cannot list the items related to IP strategy and technology management in a company.
Achievement 3	Can list the items necessary for practicing quality control and health and safety management and explain the role of each item.	Can list the items necessary for practicing quality control and health and safety management.	Cannot list the items necessary for quality control and health and safety management and the items required to implement them.

Assigned Department Objectives

Culture (D), Sociability (F)

Teaching Method

Outline	This is a lecture-style course on technology management, intellectual property, and quality control. Of the 15 weeks of the course, classes from the 2nd to the 14th week will be taught by individuals who have been in charge of technology management, time management, group dynamics, fundamentals and utilization of intellectual property, fundamentals of quality control, and management systems at companies or universities, who will use their experience to teach classes on the basics of management engineering. The course will feature guest lecturers from companies so that students may understand the work and way of thinking at those companies and learn to think about the kind of work they would like to be involved in the future.

Style	Students are expected to read the textbook and handouts corresponding to the Course Guidelines in advance. There will be a report assigned for submission consisting of a review of the class, and students should ensure that they complete it.
Notice	This course is related to "Nature and Human Beings" and "Engineering Ethics." Students should utilize their strengths (i.e., doing the work they want to do) to contribute to their growth and success. Students will learn more about themselves, deepen their understanding of their field, and be able to create a goal for themselves.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Ideal Image of Human Resources, Engineers, Code of Conduct/Guidance	1
		2nd	Introduction to MOT (1)/What is Technology Management?	1,2
		3rd	Introduction to MOT (2)/Characteristics and Perspectives of Technology Management	1,2
		4th	Introduction to MOT (3) / Value Creation through Technology Management	1,2
		5th	What Companies Expect from Young Engineers	1
		6th	Engineers from Management Perspective	1
		7th	(Mid-term Examination)	
		8th	Technological Trends in Surrounding Companies and Opportunities for Engineers	1
	4th Quarter	9th	Intellectual Property (1) / Fundamentals of Intellectual Property	2
		10th	Intellectual Property (2)/Application of Intellectual Property	2
		11th	Intellectual Property (3)/Patent Information	2
		12th	Intellectual Property (4)/Patent Specification Drafting Exercise	2
		13th	Basics of Quality Control	3
		14th	Quality Management System	3
		15th	End-term Examination	
		16th	Results Announcements/Review	1,2,3

Evaluation Method and Weight (%)

	Examination	Report/Quiz	Total
Subtotal	80	20	100
Basic Proficiency	0	0	0
Specialized Proficiency	0	0	0
Cross Area Proficiency	80	20	100

Niihama College	Year	2023	Course Title	Practice in Applied Chemistry and Bioengineering 3

Course Information			
Course Code	140302	Course Category	Specialized / Compulsory
Class Format	seminar	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	改訂化学　竹内敬人 他　（東京書籍）		
Instructor			

Course Objectives

1. Provide an overview of the periodic table and the periodicity of elements.
2. Provide an overview of the states of matter.
3. Provide an overview of the properties of matter.
4. Provide an overview of changes in matter, including chemical changes and oxidation-reduction reactions.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand and accurately explain the periodicity of elements and provide an overview of the periodic table.	Capable of summarizing the periodicity of elements and the overview of the periodic table.	Unable to summarize the periodicity of elements and the overview of the periodic table.
Achievement 2	Able to understand and accurately provide an overview of the states of matter.	Able to provide an overview of the states of matter.	Unable to provide an overview of the states of matter.
Achievement 3	Able to understand and accurately provide an overview of the states of matter.	Able to provide an overview of the states of matter.	Unable to provide an overview of the states of matter.
Achievement 4	Able to understand and accurately provide an overview of the changes in matter (chemical changes, redox, etc.).	Able to provide an overview of the changes in matter (chemical changes, redox, etc.).	Unable to provide an overview of the changes in matter (chemical changes, redox, etc.).

Assigned Department Objectives

Fundamental Scientific Knowledge (A)

Teaching Method	
Outline	Continuing from Practice in Applied Chemistry and Bioengineering 2B, this course aims to deepen the understanding obtained in Chemistry 1 learned in the first year, basic biology, and Chemistry 2 studied in the second year through exercise problems. The goal is to acquire the foundational knowledge necessary for the study of specialized subjects in the third year and beyond.
Style	In class, students will submit assignments given in advance, and quizzes based on these assignments will be conducted. The quizzes will be followed by explanations, and understanding will also be assessed through regular examinations.
Notice	Specialized courses in applied biochemistry for the third year and beyond (both in the chemistry and biology majors) will require the foundational knowledge of chemistry covered in this course as well as an understanding of how to apply this knowledge. Therefore, it is essential to thoroughly grasp this foundation by repeatedly working through basic problems.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Guidance, periodic table of elements	1
		2nd	Electron arrangement of atoms	1
		3rd	Moles and reaction formulas	2
		4th	Chemical bonds and crystals	2
		5th	Gas law	3
		6th	Three states of matter	3
		7th	Midterm test	
		8th	Return of test and commentary	
	4th Quarter	9th	Solutions	3
		10th	Chemical reactions and energy	4
		11th	Chemical equilibrium	4
		12th	Acids and bases	4
		13th	Oxidation and reduction	4
		14th	Batteries and electrolysis	4
		15th	End-of-term test	
		16th	Return of test and commentary	

Evaluation Method and Weight (%)

	Examination	Quiz	Assignments	Behavior	Portfolio	Other	Total
Subtotal	70	20	0	10	0	0	100
Basic Proficiency	70	20	0	10	0	0	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Experiments in Applied Chemistry 1

Course Information			
Course Code	140423	Course Category	Specialized / Compulsory
Class Format	Experiment	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	応用化学実験1テキスト　新居浜高専・生物応用化学科編集　物理化学実験法　後藤廉平　他著		
Instructor			

Course Objectives

1. Understand the principles of measurement devices such as spectrophotometers, gas chromatographs, atomic absorption spectrophotometers, and conductivity meters, and be able to operate them correctly.
2. Acquire basic skills in physical chemistry experiments, including measurements of physical properties.
3. Consider experimental errors, reproducibility, reliability, and the treatment of significant figures.
4. Record and organize experimental data, plot them on graphs, analyze the data based on theory, and determine the desired physical quantities.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the measurement principles of spectrophotometers, gas chromatographs, atomic absorption spectrophotomers, and conductivity meters and operate them correctly.	Able to grasp the measurement principles of spectrophotometers, gas chromatographs, atomic absorption spectrophotomers, and conductivity metersand operate them correctly.	Unable to grasp the measurement principles of spectrophotometers, gas chromatographs, atomic absorption spectrophotomers, and conductivity meters and operate them correctly.
Achievement 2	Able to perform the basic operations of physical chemistry experiments, such as measurement of physical properties, with a proper understanding of their significance and implications.	Familiar with the basic operations of physical chemistry experiments, such as the measurement of physical properties.	Not familiar with the basic operations of physical chemistry experiments, such as measurement of physical properties.
Achievement 3	Able to understand and handle the treatment of experimental errors, reproducibility, reliability, and significant figures.	Able to consider the treatment of experimental errors, reproducibility, reliability, and significant figures.	Unable to understand the treatment of experimental errors, reproducibility, reliability, and significant figures.
Achievement 4	Able to record and organize experimental data, plot them on graphs, analyze the data based on theory, and determine the desired physical quantities. Able to explain the determined physical quantities in their own words.	Able to record and organize experimental data, plot them on graphs, analyze the data based on theory, and determine the desired physical quantities.	Unable to analyze data based on theory from a plot of recorded and organized experimental data.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	The course combines physical chemistry experiments with instrumental analysis experiments. Physical Chemistry Experiments: This part of the course covers experiments related to important principles, including those not covered in regular physical chemistry classes. The goal is to address the themes of these experiments, enhancing understanding of the physical meaning of the principles. Instrumental Analysis Experiments: In this segment, experiments related to important principles for understanding analytical instruments, beyond what is covered in instrumental analysis classes, are explored. The aim is to provide an understanding of operational methods and measurement principles.
Style	Each group will consist of 2 or 3 members, and each group will conduct an experiment on a specific theme within a span of two weeks. Reports are to be submitted the week following the completion of the experiment.
Notice	To ensure that the experiment goes beyond mere manual work, it is important for students to thoroughly read the textbook and reference materials before conducting the experiment. They should understand the experimental procedures and the purpose of each operation in advance. The purpose of the report is not to document personal notes but to report what has been done to others, so students must write them in a way that is easy for the reader to understand. In oral examinations, it is crucial for students to strive to explain what they have understood in their own words.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Explanation of the details of the experiments, experimental apparatus, experimental operations, and precautions in the experiments	
		2nd	Atomic absorption spectrometry and ion chromatography: Quantification of cations and anions in copper sulfate and sodium chloride mixtures	
		3rd	Measurement of temperature and humidity: Measurement of temperature using thermocouples, measurement of humidity using phosphorus pentoxide and dew point meter	
		4th	Measurement of temperature and humidity: Measurement of temperature using platinum resistors, measurement of humidity using phosphorus pentoxide and dew point meter	
		5th	Fluorescence spectroscopy: Calculation of rotational diffusion coefficients of dyes by fluorescence probe method and fluorescence polarization resolution method	
		6th	Potentiometric titration Neutralization titration	
		7th	Midterm test period	
		8th	Potentiometric titration Redox titration	

	2nd Quarter	9th	Measurement of electrical conductivity of electrolyte solutions: Aqueous sodium chloride solution	
		10th	Measurement of electrical conductivity of electrolyte solutions: Acqueous acetic acid solution	
		11th	Adsorption of oxalic acid on activated carbon (1)	
		12th	Adsorption of oxalic acid on activated carbon（2）	
		13th	Viscosity measurement of aqueous polyethylene glycol solutions (1)	
		14th	Viscosity measurement of aqueous polyethylene glycol solutions（2）	
		15th	End-of-term period	
		16th	General remarks about experimental operations and reports, etc.	
2nd Semester	3rd Quarter	1st	Same as previous semester	
		2nd		
		3rd		
		4th		
		5th		
		6th		
		7th		
		8th		
	4th Quarter	9th		
		10th		
		11th		
		12th		
		13th		
		14th		
		15th		
		16th		

Evaluation Method and Weight (%)

	Experimental results	Assignments	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	40	50	0	10	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	40	50	0	10	0	0	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Experiments in Applied Chemistry 2

Course Information			
Course Code	140424	Course Category	Specialized / Compulsory
Class Format	Experiment	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	応用化学実験2テキスト　新居浜高専・生物応用化学科　編集		
Instructor			

Course Objectives

1. Perform the fundamental operations of chemical engineering experiments and develop the ability to visualize each phenomenon through experiments in areas such as fluid dynamics, heat transfer, mass transfer, and powder handling.
2. Record and organize experimental data, plot data on graphs, analyze data based on theory, and determine the desired physical quantities.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to become skilled in the fundamental operations of chemical engineering experiments through experiments in areas such as fluid dynamics, heat transfer, mass transfer, and mass transfer, and explain each phenomenon.	Able to acquire knowledge of fundamental operations of the chemical engineering experiments through experiments in areas such as fluid dynamics, heat transfer, and mass transfer. Able to visualize each phenomenon.	Unable to acquire knowledge of the fundamental operations of chemical engineering experiments in areas such as fluid dynamics, heat transfer, and mass transfer. Unable to visualize each phenomenon.
Achievement 2	Able to record and organize experimental data, plot data on graphs, theoretically analyze data, and determine the desired physical quantities. Able to use their own words to explain physical quantities.	Able to record and organize experimental data, plot data on graphs, theoretically analyze data, and determine the desired physical quantities.	Unable to record and organize experimental data, plot data on graphs, theoretically analyze data, and determine the desired physical quantities.

Assigned Department Objectives

Specialized Knowledge (B)

Teaching Method

Outline	Students will conduct experiments related to chemical engineering. The objective is to understand the principles of each unit operation, acquire the skills to operate and control industrial equipment, and become proficient in organizing experimental data.
Style	The class will be divided into two groups and will switch with "Applied Chemistry Experiments 1" before and after the first term.

Notice	Due to the unique equipment and operations associated with chemical engineering, all experiments must be conducted with careful attention while understanding their significance. When preparing reports, students must pay close attention to physical properties and units and strive to comprehend the meaning of the obtained physical quantities. During discussions, students should make an effort to understand descriptions from textbooks and reference materials and be prepared to explain them in their own words during oral examinations. Students must also be mindful of refining their skills for each experiment. Failure to submit any reports may result in the denial of credit.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Guidance	
		2nd	Pressure loss in a pipe: Investigating the relationship between pressure loss, friction coefficient, and the Reynolds number, and understanding the theory of friction loss.	
		3rd	Pressure loss in a pipe: Investigating the relationship between pressure loss, friction coefficient, and the Reynolds number, and understanding the theory of friction loss.	
		4th	Double pipe heat exchanger: Measuring the summary heat transfer coefficient using a double pipe heat exchanger to understand the heat transfer phenomena of fluids.	
		5th	Double pipe heat exchanger: Measuring the summary heat transfer coefficient using a double pipe heat exchanger to understand the heat transfer phenomena of fluids.	
		6th	Drying rate of solids by hot air: Understanding drying phenomena through hot air drying of water-containing solid materials.	
		7th	Drying rate of solids by hot air: Understanding drying phenomena through hot air drying of water-containing solid materials.	
		8th	Particle size distribution, sedimentation, and separation: Measuring the particle size distributions of powders and granules by the Andreasen pipette method and understanding the theory of sedimentation.	
		9th	Particle size distribution, sedimentation, and separation: Measuring the particle size distributions of powders and granules by the Andreasen pipette method and understanding the theory of sedimentation.	

	2nd Quarter	10th	Constant-pressure filtration: Performing filtration experiments on slurries to determine filtration coefficients and study filtration equations.	
		11th	Constant-pressure filtration: Performing filtration experiments on slurries to determine filtration coefficients and study filtration equations.	
		12th	Droplet generation: Investigating the impact of physical factors on the generation of single droplets by dimensional analysis methods.	
		13th	Droplet generation: Investigating the impact of physical factors on the generation of single droplets by dimensional analysis methods.	
		14th	Oral examination/defense of experiment report	
		15th	End-of-term test period	
		16th	Confirmatory exercises on experimental skills	
2nd Semester	3rd Quarter	1st	Same as previous semester	
		2nd		
		3rd		
		4th		
		5th		
		6th		
		7th		
		8th		
	4th Quarter	9th		
		10th		
		11th		
		12th		
		13th		
		14th		
		15th		
		16th		

Evaluation Method and Weight (%)

	Experimental Results	Assignments	Behavior	Total
Subtotal	40	50	10	100
Basic Proficiency	0	0	0	0
Specialized Proficiency	40	50	10	100
Cross Area Proficiency	0	0	0	0

Niihama College	Year	2023	Course Title	Functional Inorganic Chemistry

Course Information			
Course Code	140522	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	工学のための無機化学［新訂版］　橋本和明　他著　（サイエンス社）、配布プリント		
Instructor			

Course Objectives

1. Interpret phase diagrams for three-component systems.
2. Understand the structure and characteristics of glass.
3. Understand the raw material composition and manufacturing process of cement.
4. Explain corrosion and corrosion prevention.
5. Systematically understand the structure, types, properties, and applications of ceramics.
6. Understand the various types and principles of all-solid-state lithium-ion batteries and fuel cells.
7. Understand hydrogen storage materials.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to interpret and explain phase diagrams for three-component systems.	Able to interpret phase diagrams for three-component systems.	Unable to interpret phase diagrams for three-component systems.
Achievement 2	Able to understand and explain the structure and characteristics of glass.	Able to understand the structure and characteristics of glass.	Unable to understand the structure and characteristics of glass.
Achievement 3	Able to understand and explain the raw material composition and manufacturing process of cement.	Able to understand the raw material composition and manufacturing process of cement.	Unable to understand the raw material composition and manufacturing process of cement.
Achievement 4	Able to understand and explain corrosion and corrosion prevention.	Able to understand corrosion and corrosion prevention.	Unable to understand corrosion and corrosion prevention.
Achievement 5	Able to systematically understand and explain the structure, types, properties, and application of ceramics.	Able to systematically understand the structure, types, properties, and application of ceramics.	Unable to systematically understand the structure, types, properties, and application of ceramics.
Achievement 6	Able to understand and explain the types and principles of all-solid-state lithium-ion batteries and fuel cells.	Able to understand the types and principles of all-solid-state lithium-ion batteries and fuel cells.	Unable to understand the types and principles of all-solid-state lithium-ion batteries and fuel cells.
Achievement 7	Able to understand and explain hydrogen storage materials.	Able to understand hydrogen storage materials.	Unable to understand hydrogen storage materials.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	With a focus on the relationship between inorganic materials and the environment, this course delves into representative industrial sectors of inorganic chemistry, encompassing glass, cement, batteries, and hydrogen storage materials. Additionally, it covers the recently highlighted area of fine ceramics. Students will also gain an understanding of interpreting three-component phase diagrams and corrosion prevention in this context.
Style	To enhance the understanding of the relationship between environmental science and inorganic functional chemistry, topics related to the environment will be incorporated into the curriculum in weeks 4, 6, and 10–15. Assignments will be provided regularly.
Notice	Building on the foundation of inorganic chemistry learned up to the fourth year, the course will progress by incorporating new information from industries pertaining to glass, cement, ceramics, and batteries.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Interpreting phase diagrams for three-component systems	1
		2nd	Glass (1): Fundamentals and properties	2
		3rd	Glass (2): Manufacturing technology	2
		4th	Glass (3): Applications	2
		5th	Cement (1): Fundamentals and properties	3
		6th	Cement (2): Manufacturing technology and applications	3
		7th	Mid-term test	1,2,3
		8th	Corrosion and corrosion prevention	4
	2nd Quarter	9th	Ceramics (1): Fundamentals and properties	5
		10th	Ceramics (2): Structural materials (1)	5
		11th	Ceramics (3): Structural materials (2)	5
		12th	Ceramics (4): Functional materials (1)	5
		13th	Ceramics (5): Functional materials (2)	5
		14th	All-solid-state lithium-ion batteries, fuel cells, and hydrogen storage materials	6,7
		15th	End-of-term test	4,5,6
		16th	Energy storage and transportation technologies	7

Evaluation Method and Weight (%)

	Examination	Assignments	Quiz	Total
Subtotal	80	5	15	100
Basic Proficiency	0	0	0	0
Specialized Proficiency	80	3	15	98
Cross Area Proficiency	0	2	0	2

Niihama College	Year	2023	Course Title	Material Chemistry

Course Information			
Course Code	140523	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	配布プリント		
Instructor			

Course Objectives

1. Able to define the basic concepts of stress, strain, shear stress, shear strain, Young's modulus, and Poisson's ratio, and to perform simple calculations.
2. Able to describe elastic deformation and plastic deformation.
3. Able to define the basic concept of stress generation due to the environment, and to perform simple calculations.
4. Able to explain the basic concepts of material testing methods, and structure and strength, and to perform simple calculations.
5. Able to explain the basic concept of forces acting on beams, and to perform simple calculations.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to define the basic concepts of stress, strain, shear stress, shear strain, Young's modulus, and Poisson's ratio, perform simple calculations.	Able to define the basic concepts of stress, strain, shear stress, shear strain, Young's modulus, and Poisson's ratio, and perform simple calculations.	Able to define the basic concepts of stress, strain, shear stress, shear strain, Young's modulus, and Poisson's ratio.
Achievement 2	Able to describe elastic deformation and plastic deformation.	Able to describe elastic deformation and plastic deformation.	Unable to describe elastic deformation and plastic deformation.
Achievement 3	Able to define the basic concept of stress generation due to the environment, perform simple calculations.	Able to define the basic concept of stress generation due to the environment, and perform simple calculations.	Unable to define the basic concept of stress generation due to the environment.
Achievement 4	Able to explain the basic concepts of material testing methods, and structure and strength, perform simple calculations.	Able to explain the basic concepts of material testing methods, and structure and strength, and perform simple calculations.	Unable to explain the basic concepts of material testing methods, and structure and strength.
Achievement 5	Able to explain the basic concept of the forces acting on beams, perform simple calculations.	Able to explain the basic concept of the forces acting on beams, and perform simple calculations.	Unable to explain the basic concept of the forces acting on beams.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	Learn about mechanical properties (basic material mechanics), focusing on metallic materials.
Style	The course will be conducted with classes and review tests. Material mechanics is an important field for working in a company as a chemical engineer.
Notice	An understanding of mechanical properties is important for courses on inorganic materials (ceramics, glass, metals) included in the second semester of Inorganic Chemistry 2 taught in the 4th grade and those on inorganic functional chemistry taught in the first semester of the 5th grade and organic polymer materials included in organic functional chemistry taught in the 5th grade. The basic concepts of material mechanics are to be learned while actually calculating and obtaining properties such as the material strength, etc.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Stress and strain	1
		2nd	Tensile stress and compressive stress	1
		3rd	Shear stress (1)	1
		4th	Shear stress (2) Allowable stress and safety factor	1
		5th	Young's modulus, Hooke's law Stress-strain diagram	1
		6th	Poisson's ratio Stress-strain relationship in the plastic region	1,2
		7th	Midterm examination	1,2
		8th	Thermal effect	1,3
	4th Quarter	9th	Stress concentration	1,3
		10th	Strain temporal change and fatigue Strain rate effect	1,2,3
		11th	Stress due to its own weight Effects of internal pressure	1,3
		12th	Crystal defects Structure and strength of polycrystalline bodies	4
		13th	Strength of composite materials	1,4
		14th	Forces acting on beams	5
		15th	Final examination	1,2,3,4,5
		16th	Material testing methods	4

Evaluation Method and Weight (%)

	Examination	Quiz		Total
Subtotal	80	20		100
Basic Proficiency	0	0		0
Specialized Proficiency	80	20		100
Cross Area Proficiency	0	0		0

Niihama College	Year	2023	Course Title	Chemical Engineering 3

Course Information			
Course Code	140525	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	化学工学概論　小菅人慈　監修　（実教出版）／参考書：解説化学工学　竹内雍　他著　（培風館）・よくわかる化学工学　石井宏幸　他著　（森北出版）・化学系学生のための化学工学　森秀樹　他共編著　（培風館）・ベーシック化学工学　橋本健治　著　（化学同人）　など		
Instructor			

Course Objectives

1. Able to read the phase diagram of a binary system vapor-liquid equilibrium and calculate the relative volatility.
2. Able to perform basic calculations for simple distillation and continuous simple distillation.
3. Able to obtain the theoretical plate number of a continuous distillation column by the McCabe-Thiele method.
4. Able to calculate the absorption equilibrium based on Henry's law and absorption rate using the mass transfer coefficient.
5. Able to calculate the mass balance of an absorption tower and obtain the tower height.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to read the phase diagram of a binary system vapor-liquid equilibrium and calculate relative volatility	Able to read the phase diagram of a binary system vapor-liquid equilibrium	Unable to read the phase diagram of a binary system vapor-liquid equilibrium
Achievement 2	Able to explain the principles of simple distillation and continuous simple distillation, and perform calculations	Able to perform basic calculations for simple distillation and continuous simple distillation	Unable to perform basic calculations for simple distillation and continuous simple distillation
Achievement 3	Able to explain the principles of the McCabe-Thiele method, and calculate the theoretical plate number of a continuous distillation column in relation to the reflux ratio	Able to calculate the theoretical plate number of a continuous distillation column by the McCabe-Thiele method in relation to the reflux ratio	Unable to obtain the theoretical plate number of a continuous distillation column by the McCabe-Thiele method
Achievement 4	Able to explain and calculate absorption rate using gas dissolution equilibrium based on Henry's law and mass transfer coefficient	Able to calculate absorption rate using gas dissolution equilibrium based on Henry's law and mass transfer coefficient	Unable to calculate absorption rate using gas dissolution equilibrium based on Henry's law and mass transfer coefficient

Achievement 5	Able to calculate concentration based on mass balance of the absorption tower, and based on that, obtain the tower height by calculating the HTU and NTU	Able to calculate the concentration based on the mass balance of the absorption tower and obtain the tower height from the HTU and NTU	Unable calculate the concentration based on the mass balance of the absorption tower and tower height from HTU and NTU
Assigned Department Objectives			
Specialized Knowledge (B)			
Teaching Method			
Outline	Understand the principles of diffusion separation operation based on mass transfer, and learn the basics of device design by taking up distillation and gas absorption as representative operations of step contact method and differential contact method, respectively. Diffusion separation operation is an important operation alongside reaction operation in chemical industry. This course contains the most basic and important matters of the device design calculation, and want you to make sure you learn it.		
Style	Assuming preparation at home using video teaching materials, proceed with focus on exercises during class (flipped classroom). In the exercises, students should try to solve the problems while discussing with each other.		
Notice	In order to understand this course, knowledge of Mathematics (Calculus), Physical Chemistry 1 (Phase Equilibrium), and Chemical Engineering 1 (Balance Calculation) is required. This course is an academic credit course (2 credits), and the total study time is 90 hours. (The breakdown is 30 hours of class time and 60 hours of self-study time.) Self-study equivalent to 60 hours is necessary for credit approval, and this self-study time shall include self-study assignments from the faculty in charge, preparation review time for classes, discussion time for practice assignments to deepen understanding, and learning time for exam preparation.		
Characteristics of Class / Division in Learning			
☑ Active Learning	☐ Aided by ICT	☑ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st	1st Quarter	1st	Distillation: Vapor-liquid equilibrium of binary systems	1
		2nd	Distillation: Vapor-liquid equilibrium of an ideal solution	1
		3rd	Distillation: Simple distillation	2
		4th	Distillation: Continuous simple distillation	2
		5th	Distillation: Principles of continuous distillation and mass balance	3
		6th	Distillation: Theoretical plate number of continuous distillation column	3
		7th	Midterm examination	
		8th	Results of examination	

Semester	2nd Quarter	9th	Gas absorption: Gas dissolution equilibrium	4
		10th	Gas absorption: Absorption tower	4
		11th	Gas absorption: Absorption rate and two film theory	4
		12th	Gas absorption: Mass balance of absorption tower	5
		13th	Gas absorption: Tower height of absorption tower	5
		14th	Gas absorption: Analytical solution for the number of transfer units	5
		15th	Final examination	
		16th	Results of examination	

Evaluation Method and Weight (%)

	Examination	Assignments	Total
Subtotal	80	20	0
Basic Proficiency	0	0	0
Specialized Proficiency	80	20	0
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Chemical Engineering 4

Course Information

Course Code	140526	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	教科書　FirstStageシリーズ　化学工学概論　小菅人慈（実教出版）／ 参考書　ベーシック化学工学　橋本健治　著（化学同人）・解説化学工学改訂版　竹内雍　他著（培風館）・基礎からわかる化学工学　石井宏幸　他著（森北出版）・化学系学生のための化学工学　森秀樹　他共編著　（培風館）・トコトンやさしい膜分離の本　伊東章　著（日刊工業新聞社）・ よくわかる分離膜の基礎　中尾真一　編著（工業調査会）・反応工学　草壁克己　他著（三共出版）など		
Instructor			

Course Objectives

1. Describe the types and characteristics of homogeneous reaction vessels, as well as the types of heterogeneous reaction vessels.
2. Foster proficiency in understanding and interpreting three-component phase diagrams to determine three-component system extraction equilibrium relationships, including the ability to calculate single and multiple extractions.
3. Elucidate the characteristics of major adsorbents and the principles of fixed-bed adsorption operations, and perform basic calculations for adsorption isotherms and batch adsorption operations.
4. Explain the characteristics of major membrane separation methods and perform basic calculations related to separation membrane rejection and permeability flux.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the types and characteristics of homogenous reaction vessels as well as types of heterogenous reaction vessels.	Able to explain the types of homogenous and heterogenous reaction vessels.	Unable to explain the types of homogenous and heterogenous reaction vessels.
Achievement 2	Able to interpret three-component phase diagrams to understand three-component system extraction equilibrium and perform calculations for single extraction and multiple extractions.	Able to interpret three-component phase diagrams to understand three-component system extraction equilibrium and perform calculations for single extraction.	Unable to interpret three-component phase diagrams to understand three-component system extraction equilibrium and perform calculations for single extraction.
Achievement 3	Able to explain the characteristics of major adsorbents and the principles of fixed-bed adsorption operations, and perform basic calculations for adsorption isotherms and batch adsorption operations.	Able to explain the characteristics of major adsorbents and perform basic calculations for adsorption isotherms and batch adsorption operations.	Unable to explain the characteristics of major adsorbents and perform basic calculations for adsorption isotherms and batch adsorption operations.

Achievement 4	Able to explain the characteristics of major separation methods and perform basic calculations related to separation membrane rejection and permeability flux.	Able to explain the characteristics of major separation methods and perform basic calculations related to separation membrane rejection.	Unable to explain the characteristics of major separation methods and perform basic calculations related to separation membrane rejection.

Assigned Department Objectives	
Specialized Knowledge (B)	
Teaching Method	
Outline	In this course, students will learn about reaction operations and diffusion separation operations, and acquire the fundamentals of instrumentation and process design and analysis.
Style	The class is based on the assumption that students will prepare at home using video materials, and during the class, the focus will be on exercises (flipped classroom). In the exercises, students are encouraged to discuss and solve problems together.
Notice	The students will study a wide range of chemical engineering fields, including reaction operations and diffusion separation operations, so they should concentrate during class and actively engage in exercises. This course is a two-credit-unit course with a total study time of 90 hours (including 30 hours of class time and 60 hours of self-study). To receive credit, a mandatory 60 hours of self-study is required, which includes assignments for self-study provided by the instructor, preparation and review time for classes, discussion time for exercise assignments to deepen understanding, and study time for exam preparation.

Characteristics of Class / Division in Learning			
☑ Active Learning	☐ Aided by ICT	☑ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Reaction vessels: Homogenous reaction vessels	1
		2nd	Reaction vessels: Heterogenous reaction vessels	1
		3rd	Extraction: Principles of extraction, ternary plots	2
		4th	Extraction: Liquid–liquid equilibrium	2
		5th	Extraction: Single extraction	2
		6th	Extraction: Multiple extraction	2
		7th	Midterm test	
		8th	Return of test	
	4th Quarter	9th	Adsorption: Principles of adsorption and adsorbents	
		10th	Adsorption: Adsorption isotherm	3
		11th	Adsorption: Principles of batch adsorption and fixed-bed adsorption	3
		12th	Membrane separation: Principles of membrane separation	3
		13th	Membrane separation: Membrane filtration	4
		14th	Membrane separation: Dialysis, gas separation	4
		15th	End-of-term test	4
		16th	Return of test	

Evaluation Method and Weight (%)			
	Examination	Assignments	Total
Subtotal	80	20	0
Basic Proficiency	0	0	0
Specialized Proficiency	80	20	0
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Experiments in Biotechnology 1

Course Information

Course Code	140423	Course Category	Specialized / Compulsory
Class Format	Experiment	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	First Semester	Classes per Week	4
Textbook and/or Teaching Materials	生物工学実験1テキスト　新居浜高専・生物応用化学科　編集　ビギナーのための微生物実験ラボガイド　講談社　バイオ実験を安全に行うために　化学同人編集部 編　（化学同人）		
Instructor			

Course Objectives

1. Ability to handle microorganisms, including preparation of culture medium, inoculation of microorganisms, and observation of microorganisms using a microscope
2. Ability to detect/quantify and isolate/purify biochemical substances and microorganisms
3. Ability to obtain the desired physical quantities by recording and organizing experimental data, to plot these data on diagrams, and to analyze the data based on theory

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to handle microorganisms, including preparing culture medium, inoculating microorganisms, and observing microorganisms using a microscope, after understanding the concepts.	Able to handle microorganisms, such as preparing culture medium, inoculating microorganisms, and observing microorganisms using a microscope.	Unable to handle microorganisms, such as preparing culture medium, inoculating microorganisms, and observing microorganisms using a microscope.
Achievement 2	Able to detect/quantify and isolate/purify biochemical substances and microorganisms, and able to explain the meaning of each operation.	Able to detect/quantify and isolate/purify biochemical substances and microorganisms.	Unable to detect/quantify and isolate/purify biochemical substances and microorganisms.
Achievement 3	To obtain the desired physical quantities by recording and organizing experimental data, to plot these data on diagrams, and to analyze the data based on theory. Able to explain in your own words about the obtained physical quantities.	To obtain the desired physical quantities by recording and organizing experimental data, to plot these data on diagrams, and to analyze the data based on theory.	Unable to analyze data based on theory from the plots of diagrams prepared by recording and organizing experimental data.

Assigned Department Objectives

Specialized Knowledge (B)

Teaching Method				
Outline	Conduct basic experiments in biotechnology and acquire basic techniques for handling microorganisms and biochemical substances.			
Style	The contents of these experiments are all about the basics of biotechnology, and basic knowledge of fundamental biology, microbiology, and biochemistry is necessary. Some experiments require the use of analytical equipment, so be sure to study their principles in advance.			
Notice	Each individual should carefully follow precautions, such as using a white coat and washing hands after the experiment, and take part in the experiments with great care.			
Characteristics of Class / Division in Learning				
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced	

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	At the time of starting the experiment: Precautions for handling microorganisms and biological materials Experiment explanation and exercises	
		2nd	Size, staining, and detection of microorganisms	
		3rd	Observation and measurement of chromosomes	
		4th	Quantification of proteins	
		5th	Quantification of vitamin C	
		6th	Preparation of buffer solution	
		7th	Midterm examination period	
		8th	Absorption coefficient measurement	
	2nd Quarter	9th	Desalination of proteins by gel filtration	
		10th	Dialysis membrane and Donnan's membrane equilibrium	
		11th	Preparation of lipid-degrading bacteria isolation medium and sample application	
		12th	Detection and isolation of lipid-degrading bacteria	
		13th	Purification of lysozyme protein from egg whites	
		14th	Isolation-purification and analysis of neutral lipids from egg yolks	
		15th	Final examination period	
		16th	Summary of experiments and arrangement of experimental equipment	
2nd	3rd Quarter	1st		
		2nd		
		3rd		
		4th		
		5th		
		6th		
		7th		
		8th		

Semester	4th Quarter	9th		
		10th		
		11th		
		12th		
		13th		
		14th		
		15th		
		16th		

Evaluation Method and Weight (%)

	Experimental results	Assignments	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	40	50	0	10	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	40	50	0	10	0	0	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Experiments in Biotechnology 2

Course Information			
Course Code	140434	Course Category	Specialized / Compulsory
Class Format	Experiment	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Second Semester	Classes per Week	4
Textbook and/or Teaching Materials	生物工学実験2テキスト　新居浜高専・生物応用化学科　　ビギナーのための微生物実験ラボガイド　講談社 バイオ実験を安全に行うために　　化学同人編集部 編　　（化学同人）		
Instructor			

Course Objectives

1. Ability to measure enzyme reactions and microbial growth rates
2. Ability to perform basic operations of DNA experiments such as DNA extraction and electrophoresis
3. Ability to obtain the desired physical quantities by recording and organizing experimental data, to plot these data on diagrams, and to analyze the data based on theory

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to measure enzyme reactions and microbial growth rates and to explain the meaning of each operation.	Able to measure enzyme reactions and microbial growth rates.	Unable to measure enzyme reactions and microbial growth rates.
Achievement 2	Able to perform basic operations of DNA experiments such as DNA extraction and electrophoresis and to explain the meaning of each operation.	Able to perform basic operations of DNA experiments such as DNA extraction and electrophoresis.	Unable to perform basic operations of DNA experiments such as DNA extraction and electrophoresis.
Achievement 3	Able to obtain the desired physical quantities by recording and organizing experimental data, to plot these data on diagrams, to analyze the data based on theory, and to explain in your own words about the obtained physical quantities.	To obtain the desired physical quantities by recording and organizing experimental data, to plot these data on diagrams, and to analyze the data based on theory.	Unable to analyze data based on theory from the plots of diagrams prepared using recorded and organized experimental data.

Assigned Department Objectives

Specialized Knowledge (B)

Teaching Method

Outline	Conduct more advanced experiments in microbiology and biochemistry following Experiments in Biotechnology 1 to master the basics of biotechnology.

Style	These experiments require the basic knowledge of basic Biology 1 and 2, Microbiology, Biochemistry 1, and Biophysical Chemistry 1. Some experiments use analytical equipment, so it is necessary to study their principles in advance. For the examination of the experiment report, you should look up the necessary knowledge in reference books in the library, etc. and work on it after understanding the concepts well.
Notice	In these experiments, some of the contents will be learned through experiments before the lecture, so it is important to carry out the experiments by reading the textbook carefully before the experiment and understanding the purpose of the experimental operation. Each one should carefully follow precautions such as using a white coat and washing hands after the experiment, and take part in the experiment with great care.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Explanation of experiments and exercises related to experiments	
		2nd	Alcohol fermentation 1: Preparation of culture medium and inoculation	3
		3rd	Alcohol fermentation 2: Distillation, titration, and quantification of alcohol	3
		4th	Measurement of proteolytic enzyme activity	1,3
		5th	Enzyme kinetics	1,3
		6th	Activation of enzymes	1,3
		7th	Midterm examination period	
		8th	Inhibition of enzymes	1,3
	4th Quarter	9th	Measurement of spoilage degree of fats and oils	1,3
		10th	Superoxide dismutase (SOD) activity measurement in food	1,3
		11th	O-F test of *Escherichia coli*	3
		12th	Creating a growth curve for *Escherichia coli*	1,3
		13th	Extraction of chromosomal DNA from *Escherichia coli*	2
		14th	DNA detection and purity test	2,3
		15th	Final examination period	
		16th	Summary of experiments and arrangement of experimental equipment	

Evaluation Method and Weight (%)

	Experimental results	Assignments	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	40	50	0	10	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	40	50	0	10	0	0	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Applied Microbiology

Course Information			
Course Code	140531	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	教科書：応用微生物学　村尾澤夫、荒井基夫　編　（培風館）／参考書：微生物工学　百瀬春生　編　（丸善）		
Instructor			

Course Objectives

1. Ability to explain the outline of the history of the development of microbiology.
2. Ability to explain about the industries that use microorganisms and their characteristics.
3. Ability to explain the metabolism and utilization of microorganisms.
4. Ability to explain the outline of the growth and culture methods of microorganisms.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain about the scientists who contributed to the development of microbiology and their achievements, considering also their impact on mankind.	Able to explain about the scientists who contributed to the development of microbiology and their achievements.	Unable to explain about the scientists who contributed to the development of microbiology and their achievements.
Achievement 2	Able to explain about the industries that use microorganisms and their characteristics citing several concrete examples.	Able to briefly explain about the industries that use microorganisms and their characteristics.	Unable to explain about the industries that use microorganisms and their characteristics.
Achievement 3	Able to clearly explain about substance production and environmental purification processes that use the metabolism of microorganisms by citing several examples.	Able to briefly explain about substance production and environmental purification processes that use the metabolism of microorganisms.	Unable to explain about substance production and environmental purification processes that use the metabolism of microorganisms.
Achievement 4	Able to clearly understand the growth measurement and culture methods of microorganisms and obtain mass balance by setting up the mass balance equation in cultures.	Able to understand the growth measurement and culture methods of microorganisms and obtain the basic mass balance in cultures.	Unable to obtain the mass balance in microbial cultures.

Assigned Department Objectives

Specialized Knowledge (B)

Teaching Method	
Outline	Using the capabilities of microorganisms, various technologies that are useful to mankind have been established. In this lecture, acquire techniques for using microorganisms in engineering while learning about the metabolism of various substances that occur within microbial cells and methods for culturing microorganisms.
Style	Basic knowledge of microbiology and biochemistry is necessary to improve the level of understanding of the contents of the lecture, so be sure to review thoroughly before attending this lecture. In addition, the contents of this lecture will lead to the lectures on fermentation engineering in the second-semester.
Notice	As the various functions of microorganisms, enzymes, etc. are explained in a simple language, the aim is for you to improve your level of understanding sufficiently.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	History of microbiology (1)	1
		2nd	History of microbiology (2)	1
		3rd	Development of applied microbiology and application to industries	2
		4th	Carbohydrate degradation and conversion (1)	3
		5th	Carbohydrate degradation and conversion (2)	3
		6th	Respiration and energy	3
		7th	Midterm examination	
		8th	Metabolism and biosynthesis of fatty acids	3
	2nd Quarter	9th	Synthesis of biomolecules	3
		10th	Outline of bioprocess	4
		11th	Mass balance of biological reactions	4
		12th	Growth of microorganisms	4
		13th	Growth kinetic analysis	4
		14th	Culture techniques of microorganisms	4
		15th	Final examination	
		16th	Return and review of examination	

Evaluation Method and Weight (%)				
	Examination	Assignments	Quiz	Total
Subtotal	80	20	0	100
Basic Proficiency	0	0	0	0
Specialized Proficiency	80	20	0	100
Cross Area Proficiency	0	0	0	0

Niihama College	Year	2023	Course Title	Fermentation Technology

Course Information			
Course Code	140536	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	教科書：応用微生物学　村尾澤夫、荒井基夫　編　（培風館）／参考書：微生物工学　百瀬春生　編　（丸善）		
Instructor			

Course Objectives

1. Ability to explain the growth of microorganisms and the effects of environmental conditions on their growth.
2. Ability to explain microbial breeding using mutation methods.
3. Ability to explain the outline of brewing using microorganisms, fermented foods, and amino acid production.
4. Ability to explain the outline of wastewater treatment using microorganisms.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand and clearly explain the growth of microorganisms and the effects of environmental conditions on their growth.	Able to explain the outline of the growth of microorganisms and the effects of environmental conditions on their growth.	Unable to explain the outline of the growth of microorganisms and the effects of environmental conditions on their growth.
Achievement 2	Able to explain the types of mutation methods and the methods for selecting mutant strains by providing examples.	Able to explain the outline of the types of mutation methods and the methods for selecting mutant strains.	Unable to explain the outline of the types of mutation methods and the methods for selecting mutant strains.
Achievement 3	Able to understand the principles of brewing using microorganisms, fermented foods, and amino acid production methods and explain these by providing examples.	Able to explain the outline of brewing using microorganisms, fermented foods, and amino acid production methods.	Unable to explain the outline of brewing using microorganisms, fermented foods, and amino acid production methods.
Achievement 4	Able to accurately understand the principles of water treatment methods using microorganisms and explain these with concrete examples.	Able to explain the outline of water treatment methods using microorganisms.	Unable to explain the outline of water treatment methods using microorganisms.

Assigned Department Objectives

Specialized Knowledge (B)

Teaching Method

Outline	Microorganisms are utilized in traditional fermented foods, pharmaceutical manufacturing, wastewater treatment, etc. In this lecture, first learn the methods of isolation and breeding of microorganisms and then learn practical application cases to deepen the basic understanding of the microbial industry.

Style	Microorganisms are actively used in fields such as the food industry, healthcare, environmental purification, etc., and have become indispensable to mankind. Explanation of utilization methods of these microorganisms will be given in simple language, from the basics to the applications, so that you to understand these well.
Notice	To aid understanding, be sure to acquire the basics of microbiology, microbial engineering, and biochemistry.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Microbial growth and environmental conditions	
		2nd	Microbial nutrition	
		3rd	Isolation of effective microorganisms	
		4th	Improvement of microorganisms through mutation (1)	
		5th	Improvement of microorganisms through mutation (2)	
		6th	Fermented and brewed foods (alcoholic beverages)	
		7th	Midterm examination	
		8th	Fermented and brewed foods (alcoholic beverages)	
	4th Quarter	9th	Fermented and brewed foods (fermented foods)	
		10th	Organic acid fermentation	
		11th	Amino acid fermentation	
		12th	Nucleic acid fermentation, antibiotics	
		13th	Environmental purification using microorganisms (1)	
		14th	Environmental purification using microorganisms (2)	
		15th	Final examination	
		16th	Return and review of examination	

Evaluation Method and Weight (%)

	Examination	Assignments	Quiz	Total
Subtotal	80	20	0	100
Basic Proficiency	0	0	0	0
Specialized Proficiency	80	20	0	100
Cross Area Proficiency	0	0	0	0

Niihama College	Year	2023	Course Title	Biocatalysis

Course Information

Course Code	140538	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	参考書　コーン・スタンプ生化学　田宮信雄、八木達彦　訳　（東京化学同人）　酵素ー科学と工学　虎谷哲夫　他　（講談社）　酵素工学概論　田中渥夫　他　（コロナ社）　など		
Instructor			

Course Objectives

1. Ability to explain the basic knowledge of enzymes
2. Ability to explain enzyme purification and analysis methods
3. Ability to understand the kinetic analysis method of enzymes and obtain the maximum reaction rate, Michaelis constant, and inhibitor constant
4. Ability to explain the outline of enzyme production and the control mechanism of its biosynthesis

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the properties of enzymes by providing many concrete examples	Able to explain the outline of the properties of enzymes	Unable to explain about the properties of enzymes
Achievement 2	Able to explain enzyme purification and analysis methods by providing many concrete examples	Able to explain enzyme purification and analysis methods	Unable to explain enzyme purification and analysis methods
Achievement 3	Able to accurately understand the meaning of enzyme reaction rate parameters and obtain the Michaelis constant, maximum reaction rate, and inhibitor constant and be able to discuss the properties of the enzyme based on these	Able to understand the outline of enzyme reaction rate parameters, and obtain the Michaelis constant and maximum reaction rate	Unable to obtain the maximum reaction rate and the Michaelis constant of enzymes
Achievement 4	Able to accurately explain the regulation of enzyme synthesis in detail	Able to explain the outline of the regulation of enzyme synthesis	Unable to explain the regulation of enzyme synthesis
Achievement 5	Able to accurately explain substance production by enzymes along with concrete examples	Able to explain the outline of substance production by enzymes	Unable to explain about substance production by enzymes

Assigned Department Objectives

Specialized Knowledge (B)	
Teaching Method	
Outline	All chemical reactions inside living organisms are catalyzed and controlled by enzymes. In this lecture, students will learn the basics and applications of reactions performed by various enzymes (also called biocatalysts).
Style	Ask questions as appropriate in a lecture format and proceed while confirming the level of understanding.
Notice	Advice for taking the course The basics and application of enzymatic reactions can be said to be the most important foundation of biological engineering. Of course, it goes without saying that it is important to acquire basic knowledge; however, as applied topics will also be incorporated into the lecture as appropriate, use reference books if necessary. This course is a study unit course (2 credits), and the total study time is 90 hours. (The breakdown is 30 hours of class time and 60 hours of self-study time.) Self-study equivalent to 60 hours is necessary for credit approval, and this self-study time shall include self-study assignments from the faculty in charge, preparation review time for classes, discussion time for practice assignments to deepen understanding, and learning time for exam preparation. Prior learning: self-study and related courses Learn Biochemistry 1 and bioorganic chemistry 2B well.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	History of enzyme research	
		2nd	Classification and nomenclature of enzymes	
		3rd	Properties of enzymes	
		4th	Enzyme extraction	
		5th	Purification and analysis of enzymes (1)	
		6th	Purification and analysis of enzymes (2)	
		7th	Midterm examination	
		8th	Enzyme kinetics	
	2nd Quarter	9th	Enzyme inhibition mode (1)	
		10th	Enzyme inhibition mode (2)	
		11th	Control of enzyme biosynthesis (1)	
		12th	Control of enzyme biosynthesis (2)	
		13th	Regulation of enzyme activity	
		14th	Immobilization of enzymes and application of enzymes to substance production	
		15th	Final examination	
		16th	Return and review of examination	

Evaluation Method and Weight (%)

	Examination	Assignments	Quiz	Total
Subtotal	80	20	0	100
Basic Proficiency	0	0	0	0
Specialized Proficiency	80	20	0	100
Cross Area Proficiency	0	0	0	0

Niihama College	Year	2023	Course Title	Molecular Biology

Course Information			
Course Code	140537	Course Category	Specialized / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	基礎講義遺伝子工学Ⅰ　山岸明彦著　（東京化学同人）		
Instructor			

Course Objectives

1. Ability to explain antibody structure and functions.
2. Ability to explain the structure and functions of DNA and RNA
3. Ability to explain the outline of the creation of recombinant plasmids.
4. Ability to explain the base sequence determination method for genes, amplification method, etc.
5. Ability to explain application examples of genetic modification technology and its safety.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the structure and functions of antibodies and their application with multiple examples	Able to explain the outline of the structure and functions of antibodies	Unable to explain the structure and functions of antibodies
Achievement 2	Able to explain the structure and functions of DNA and RNA accurately and in detail.	Able to explain the outline of the structure and functions of DNA and RNA.	Unable to explain the structure and functions of DNA and RNA.
Achievement 3	Able to explain the creation of recombinant plasmids accurately and concretely.	Able to explain the outline of the creation of recombinant plasmids.	Unable to explain the outline of the creation of recombinant plasmids.
Achievement 4	Able to understand the principles of base sequence determination method for DNA and the principles of the PCR method and explain example applications.	Able to explain the outline of the principles of base sequence determination method for DNA and the principles of the PCR method.	Unable to explain the outline of the principles of base sequence determination method for DNA and the principles of the PCR method.
Achievement 5	Able to explain the application examples and safety of the genetic modification technology by providing multiple examples.	Able to explain the outline of application examples and safety of the genetic modification technology.	Unable to explain the outline of application examples and safety of the genetic modification technology.

Assigned Department Objectives

Specialized Knowledge (B)

Teaching Method	
Outline	Molecular biology is the study of complex biological phenomena at the molecular level, and advances in the field of molecular biology have led to the creation of a technology called genetic engineering including gene therapy and gene recombination. In this lecture, based on the molecular knowledge of biomolecules, students will understand the basics of molecular biology and the outline of genetic engineering technology as its application.
Style	A knowledge of molecular biology, which helps understand living organisms from the molecular level in which they actually function, is important as the knowledge of basic research to deepen the understanding of life. Classes will be conducted in a lecture format and will proceed with asking questions as appropriate.
Notice	To ensure understanding, it is important to acquire basic knowledge of biochemistry such as Biochemistry 1, 2, Bioorganic chemistry 2A, 2B, etc. This course is a study unit course (2 credits), and the total study time is 90 hours. (The breakdown is 30 hours of class time and 60 hours of self-study time.) Self-study equivalent to 60 hours is necessary for credit approval, and this self-study time shall include self-study assignments from the faculty in charge, preparation review time for classes, discussion time for practice assignments to deepen understanding, and learning time for exam preparation.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Beginning of molecular biology	
		2nd	Basics of molecular biology (antibodies)	1
		3rd	Basics of molecular biology (DNA and RNA)	2
		4th	DNA replication	2
		5th	Synthesis of RNA (transcription) Synthesis of protein (translation)	2
		6th	Gene mutation and restoration	2
		7th	Midterm examination	
		8th	Transformation and host vector system	3
	4th Quarter	9th	Gene separation and purification	3
		10th	Cleavage and binding of DNA molecules and transformation	3
		11th	Detection of specific genes	3
		12th	Structural analysis of genes	4
		13th	In vitro gene amplification (PCR)	4
		14th	Use and safety of genetic engineering	5
		15th	Final examination	
		16th	Return and review of examination	

Evaluation Method and Weight (%)

	Examination	Assignments	Quiz	Total
Subtotal	80	20	0	100
Basic Proficiency	0	0	0	0
Specialized Proficiency	80	20	0	100
Cross Area Proficiency	0	0	0	0

Niihama College	Year	2023	Course Title	Japanese 3

Course Information			
Course Code	101130	Course Category	General / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	精選現代文B （大修館書店）		
Instructor			

Course Objectives

1. Able to read novels, form impressions and thoughts, and express them
2. Able to acquire solid reading and comprehension skills from critical texts and write summaries

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to read and understand critiques accurately and write and present appropriate summaries and persuasive opinions	Able to read and understand the content of critiques	Unable to read or comprehend critiques
Achievement 2	Able to form impressions and thoughts and express them after reading novels	Able to understand the content and form impressions and thoughts after reading novels	Unable to understand the content of novels

Assigned Department Objectives

Culture (D)、Communication Skill (E)

Teaching Method

Outline	In this lecture, we aim to enhance the students' reading comprehension of modern texts and help them acquire the ability to think logically and express themselves. The purpose of this course is to enable students to acquire knowledge about Japanese language and culture.
Style	Comply with the textbook, supplement with handouts, etc., and proceed with the class. Take a quiz on Kanji.
Notice	Students must read modern texts that are more advanced than Japanese 1 and 2. To hone their reading comprehension, the students are expected to participate actively in class, think carefully, and speak out proactively. They must be sure to hand in all submissions and obtain a good score. This is an opportunity for students to diversify and increase their reading.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	Novel: The Moon Over the Mountain, and Other Stories (Atsushi Nakajima)	2
		2nd	Novel: The Moon Over the Mountain, and Other Stories (Atsushi Nakajima)	2
		3rd	Novel: The Moon Over the Mountain, and Other Stories (Atsushi Nakajima)	2
		4th	Novel: The Moon Over the Mountain, and Other Stories (Atsushi Nakajima)	2
		5th	Novel: The Moon Over the Mountain, and Other Stories (Atsushi Nakajima)	2
		6th	Novel: The Moon Over the Mountain, and Other Stories (Atsushi Nakajima)	2
		7th	Midterm examination	2
		8th	Critique: Venus de Milo (Takayuki Kiyooka)	
	2nd Quarter	9th	Critique: Venus de Milo (Takayuki Kiyooka)	1
		10th	Critique: Venus de Milo (Takayuki Kiyooka)	1
		11th	Critique: Kagaku no genzai o tou (Yoichiro Murakami)	1
		12th	Critique: Kagaku no genzai o tou (Yoichiro Murakami)	1
		13th	Critique: Kagaku no genzai o tou (Yoichiro Murakami)	1
		14th	Critique: Kagaku no genzai o tou (Yoichiro Murakami)	1
		15th	Final examination	1
		16th	Return of examination	
2nd Semester	3rd Quarter	1st	Critique: Hito o sasu kotoba (Takao Suzuki)	1
		2nd	Critique: Hito o sasu kotoba (Takao Suzuki)	1
		3rd	Critique: Hito o sasu kotoba (Takao Suzuki)	1
		4th	Novel: Bishin (Yukio Mishima)	2
		5th	Novel: Bishin (Yukio Mishima)	2
		6th	Novel: Bishin (Yukio Mishima)	2
		7th	Midterm examination	2
		8th	Critique: "Dearu" koto to "suru" koto (Masao Maruyama)	
	4th Quarter	9th	Critique: "Dearu" koto to "suru" koto (Masao Maruyama)	1
		10th	Critique: "Dearu" koto to "suru" koto (Masao Maruyama)	1
		11th	Critique: "Dearu" koto to "suru" koto (Masao Maruyama)	1
		12th	Critique: "Dearu" koto to "suru" koto (Masao Maruyama)	1
		13th	Novel: Matsu (Osamu Dazai)	1
		14th	Novel: Matsu (Osamu Dazai)	2
		15th	Final examination	2
		16th	Return of examination	

Evaluation Method and Weight (%)							
	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	80	0	0	0	0	20	100
Basic Proficiency	80	0	0	0	0	20	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Japanese 4

Course Information			
Course Code	101141	Course Category	General / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	新現代文学名作選（監修　中島国彦　明治書院）/日本語表現法		
Instructor			

Course Objectives

1. Touch on literary works and nurture rich sensibilities.
2. Broaden horizons through literary works.
3. Express logical sentences.
4. Articulate and express one's thoughts.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand the content of literary works and appreciate them subjectively and enrich one's sensibility	Able to understand the contents of literary works	Unable to understand the content of literary works
Achievement 2	Able to understand the background behind the creation of literary works and gain a progressive understanding of the period and authors	Able to understand the background behind the creation of literary works	Unable to understand the background behind the creation of literary works
Achievement 3	Able to understand the basic manner of Japanese expressions and create logical and persuasive sentences	Able to understand the basic manner of Japanese expressions	Unable to understand the basic manner of Japanese expressions
Achievement 4	Able to present your ideas in appropriate and persuasive terms	Able to express your thoughts	Unable to express your thoughts

Assigned Department Objectives

Culture (D)、Communication Skill (E)

Teaching Method

Outline	In Japanese 4, students study a wide range of literary works that they were not exposed to until the third year. Students will experience literary works, nurture a rich sense of humanity, refine their sensibility, and broaden their horizons. They will also cultivate logical writing and oral presentation skills.
Style	In class, we will use handouts in addition to textbooks during lectures that will provide portraits of writers and deepen our understanding of literary works. In addition, students will learn how to write sentences; use words, honorifics, and other Japanese expressions and will acquire the courtesy of a member of society.
Notice	Please read the contents of the textbook in advance. In addition, students shall work independently on assignments, etc., and submit them in order to attain their usual scores. This course is an academic credit course (2 credits), and the total study time is 90 hours. (The breakdown is 30 hours of class time and 60 hours of self-study time.) Self-study equivalent to 60 hours is essential for credit certification. This self-study time includes self-study assignments given by the instructor, time for preparation and review for classes, time for consideration of exercise assignments to deepen understanding, and study time for exam preparation.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Guidance on contemporary literature	1,2
		2nd	Meiji literature	1,2
		3rd	Meiji literature	1,2
		4th	Meiji literature	1,2
		5th	Japanese expressions (basic knowledge)	3
		6th	Japanese expressions (writing method)	3
		7th	Taisho literature	1,2
		8th	Taisho literature	1,2
	2nd Quarter	9th	Taisho literature	1,2
		10th	Japanese expressions (Presentation)	4
		11th	Showa literature	1,2
		12th	Showa literature	1,2
		13th	Showa literature	1,2
		14th	Japanese expressions (honorifics)	3
		15th	Final examination	
		16th	Return of examination	

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	70	0	0	0	0	30	100
Basic Proficiency	70	0	0	0	0	30	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	History 2

Course Information			
Course Code	101240	Course Category	General / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	詳説　日本史（山川出版社）		
Instructor			

Course Objectives

1. Grasp and explain the entire process of Japanese history in terms of the characteristics and changes of each era.
2. Logically explain how Japanese history has moved in relation to the world.
3. Explain history in relation to the results of archeology and folklore as well as literary history.
4. Research recent events in Japanese history and summarize them by listening to experienced people.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the entire process of Japanese history in writing based on the characteristics and changes of each era	Able to explain the entire process of Japanese history in writing based on the characteristics of each era	Unable to grasp the characteristics or changes in each era of Japanese history
Achievement 2	Able to express in writing how Japanese history has moved from the pre-modern period to the modern period in relation to the world, with a view to changes in relations within and between civilizations in East Asia	Able to explain in writing how Japanese history has moved in relation to the world based on individual events	Unable to explain how Japanese history has moved in relation to the world
Achievement 3	Able to explain history in writing based on literary history, in relation to the results of archeology and folklore	Able to explain history through enumeration based on the results of literary history, archaeology, and folklore	Unable to explain history through enumeration based on the results of literary history, archaeology, and folklore

Assigned Department Objectives

Culture(D)

Teaching Method

Outline	While surveying the modern history and pre-modern history of Japan along the passage of time, we will grasp the origin of Japanese culture in the context of major movements in Asian history and world history. Furthermore, by structurally considering the causal relationships between major historical events, students will develop comprehensive historical thinking skills and cultivate an awareness and ability to play a leading role in society.
Style	Quizzes are held, in addition to lectures and regular exams.

Notice	The movement and characteristics of Japanese history can best be grasped not as an isolated and complete phenomenon within the Japanese archipelago but as phenomena occurring within the broad movements within East Asian civilizations and between civilizations. It is necessary to cultivate the ability to explain these in detail. It is also important to fully realize that major historical movements have a great impact on our own way of life and lifestyle.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	The end of World War II and its consequences	Explain how Japanese history has moved in relation to the world based on individual events.
		2nd	The premise of World War II	Explain how Japanese history has moved in relation to the world based on individual events.
		3rd	World War II	Explain how Japanese history has moved in relation to the world based on individual events.
		4th	World War II and National Life	Explain how Japanese history has moved in relation to the world based on individual events.
		5th	Opening of Japan	Explain how Japanese history has moved in relation to the world based on individual events.
		6th	Upheaval at the end of the Edo period and the Meiji Restoration	Explain how Japanese history has moved in relation to the world based on individual events.
		7th	Midterm examination	
		8th	Fukoku kyohei and the establishment of a constitutional state	Explain how Japanese history has moved in relation to the world based on individual events.
	2nd Quarter	9th	The Sino-Japanese and Russo-Japanese Wars and international relations	Explain how Japanese history has moved in relation to the world based on individual events.
		10th	World War I and Japan	Explain how Japanese history has moved in relation to the world based on individual events.
		11th	Depression from the Washington System	Explain how Japanese history has moved in relation to the world based on individual events.
		12th	The collapse of party politics and the rise of the military	Explain how Japanese history has moved in relation to the world based on individual events.
		13th	Defeat and occupation of Japan	Explain how Japanese history has moved in relation to the world based on individual events.
		14th	Cold War regime and Japan	Explain how Japanese history has moved in relation to the world based on individual events.
		15th	Final examination	
		16th	Return of examination; Jomon/Yayoi period	Able to explain how Japanese history has moved in relation to the Asian continent based on individual events. Able to explain history through enumeration based on the results of literary history, archaeology, and folklore.
		1st	From the separation of small countries to Yamataikoku	Able to explain how Japanese history has moved in relation to the Asian continent based on individual events. Able to explain history through enumeration based on the results of literary history, archaeology, and folklore.

2nd Semester	3rd Quarter	2nd	Kofun period and Yamato government	Able to explain how Japanese history has moved in relation to the Asian continent based on individual events. Able to explain history through enumeration baased on the results of literary history, archaeology, and folklore.
		3rd	Road to Ritsuryo State	Able to explain how Japanese history has moved in relation to the Asian continent based on individual events. Able to explain history through enumeration based on the results of literary history, archaeology, and folklore.
		4th	The Ritsuryo State and its transformation	Able to explain how Japanese history has moved in relation to the Asian continent based on individual events. Able to explain history through enumeration based on the results of literary history, archaeology, and folklore.
		5th	Aristocracy and kokufu bunka	Able to explain the entire process of Japanese history in writing based on the characteristics of each period.
		6th	Manor system and samurai	Able to explain the entire process of Japanese history in writing based on the characteristics of each period.
		7th	Midterm examination	
		8th	Insei and the Taira clan government	Able to explain the entire process of Japanese history in writing based on the characteristics of each era. Able to explain history based on the results of literary history and archeology.
	4th Quarter	9th	Politics and culture in the Kamakura period	Able to explain the entire process of Japanese history in writing based on the characteristics of each era. Able to explain history based on the results of literary history and archeology.
		10th	The collapse of the Kamakura shogunate system and the turmoil of the Northern and Southern Courts	Able to explain the entire process of Japanese history in writing based on the characteristics of each era. Able to explain history based on the results of literary history and archeology.
		11th	Politics, foreign relations and culture in the Muromachi period	Able to explain the entire process of Japanese history in writing based on the characteristics of each era. Able to explain history based on the results of literary history and archeology.
		12th	From the turmoil of the Muromachi shogunate system to the Sengoku disturbance	Able to explain the entire process of Japanese history in writing from the characteristics of each era. Able to explain history based on the results of literary history and archeology.
		13th	Shokuhou Government	Able to explain the entire process of Japanese history in writing based on the characteristics of each era. Able to explain history based on the results of literary history and archeology.
		14th	Establishment of the shogunate system	Able to explain the entire process of Japanese history in writing based on the characteristics of each era. Able to explain how Japanese history has moved in relation to the world based on individual events.
		15th	Year-end examination	
		16th	Return of year-end examination, general remarks	

Evaluation Method and Weight (%)

	Examination	Deliverables/Quiz/Attitude	Behavior				Total
Subtotal	60	30	10	0	0	0	100
Basic Proficiency	60	30	10	0	0	0	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Politics and Economy

Course Information			
Course Code	101250	Course Category	General / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	【教科書】東京書籍『政治・経済』、第一学習社『最新政治・経済資料集2023』、有斐閣『ポケット六法 令和5年版』【参考書】新海誠監督『天気の子』、山田尚子監督『映画　聲の形』、木庭顕『法存立の歴史的基盤』		
Instructor			

Course Objectives

1. Structurally understand the basic concepts and theories of political science and economics.
2. Understand the political and economic phenomena in contemporary Japan from an international perspective.
3. Understand the process of social transformation and the characteristics of each period in postwar Japanese history.
4. Understand the problems seen in modern Japan and be able to present solutions.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the basic concepts of political science and economics and position them within a theoretical system	Able to understand the semantics and characteristics of the basic theories of political science and economics	Does not understand the basic concepts/theories and meanings in political science and economics in a relational manner
Achievement 2	Able to compare political and economic phenomena in contemporary Japan with the characteristics of other countries	Able to understand the characteristics of political and economic phenomena in other countries	Does not recognize the differences in the environments and conditions of each country and understand various political and economic phenomena
Achievement 3	Able to understand the causal relationships in the process of political and economic transformation in post-war Japanese society	Able to understand the chronological order of the political and economic characteristics seen in each period of postwar Japan	Does not understand the chronology of political and economic phenomena in postwar Japan
Achievement 4	Able to present solutions to the various political and economic problems seen in modern Japan	Able to understand the characteristics and causes of various political and economic issues in modern Japan	Does not have a multifaceted understanding of the political and economic issues facing modern Japan

Assigned Department Objectives

Culture (D)

Teaching Method	
Outline	The aim of this course is to teach students the skills and methods of analyzing and reflecting on contemporary political, economic, social, cultural, literary, and artistic issues based on solid evidence and reasoning after understanding the basic concepts and ideas in humanities and social sciences.
Style	The class will be conducted in a lecture format.
Notice	Students are not allowed to have private conversations during class; doing so may result in the deduction of up to 20 points.

Characteristics of Class / Division in Learning			
☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	What is Law?	1,2,3,4
		2nd	Legal Thinking and Legal Practice	1,2,3,4
		3rd	Introduction to Private Law	1,2,4
		4th	Introduction to Public Law	1,2,4
		5th	Reading Supreme Court Decisions	1,2,3,4
		6th	Respect for the Individual, Right to the Pursuit of Happiness	1,3,4
		7th	Principle of Equality	1,3,4
		8th	Freedom of Thought and Conscience	1,3,4
	2nd Quarter	9th	Religious Freedom	1,3,4
		10th	Separation between Church and State	1,2,3,4
		11th	Freedom of Expression	1,3,4
		12th	Right to Education	1,3,4
		13th	Gender and Sexuality	1,2,3,4
		14th	Final Examination	1,2,3,4
		15th	Submission of Answers	1,2,3,4
		16th		
2nd Semest	3rd Quarter	1st	Criminal Procedural Rights ①	1,3,4
		2nd	Criminal Procedural Rights ②	3,4
		3rd	Freedom of Occupation and Property Rights	3,4
		4th	Labor Law, Basic Labor Rights	1,2,3,4
		5th	Consumer Law	1,2,3,4
		6th	Eugenics	1,2
		7th	Urbanism	1,2,3,4
		8th	Renunciation of War and Pacifism ①	1

Semester	4th Quarter	9th	Renunciation of War and Pacifism ②	1
		10th	Emperor System	1,3,4
		11th	National Diet	1,3,4
		12th	Cabinet	4
		13th	Courts	2
		14th	Final Examination	1,2,3,4
		15th	Submission of Answers	1,2,3,4
		16th		

Evaluation Method and Weight (%)

	Examination	Assignments	Total
Subtotal	60	40	100
Basic Proficiency	60	40	100
Specialized Proficiency	0	0	0
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Mathematics A-3-1

Course Information			
Course Code	102330	Course Category	General / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	First Semester	Classes per Week	4
Textbook and/or Teaching Materials	高専テキストシリーズ　微分積分１　上野健爾[監修]　高専の数学教材研究会[編]（森北出版）、高専テキストシリーズ微分積分１問題集　上野健爾[監修]　高専の数学教材研究会[編]（森北出版）、高専テキストシリーズ　微分積分２　上野健爾[監修]　高専の数学教材研究会[編]（森北出版）、高専テキストシリーズ　微分積分２問題集　上野健爾[監修]　高専の数学教材研究会[編]（森北出版）		
Instructor			

Course Objectives

1. Calculate the area, volume, velocity, and position of figures using definite integrals.
2. Understand the parametric representation of curves and be able to calculate tangent equations, enclosed areas, and curve lengths.
3. Understand polar coordinates and equations and calculate the length of the curve represented by the polar equation and the area enclosed.
4. Compute improper integrals.
5. Calculate higher derivatives of simple functions, Maclaurin expansions, and Euler's formulas.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to calculate the area of a figure enclosed by graphs and the volume, velocity, and position of a solid of revolution, which can be obtained by complex definite integrals	Able to calculate the area of a figure enclosed by graphs and the volume, velocity, and position of a solid of revolution, which can be obtained by a simple definite integral	Unable to calculate the area of a figure enclosed by graphs or the volume, velocity, and position of a solid of revolution, which can be obtained by simple definite integrals
Achievement 2	Able to understand the parametric representation of curves and compute tangent vectors and tangent equations, as well as the length of parametrized curves and the enclosed area	Able to understand the parametric representation of curves and compute tangent vectors and tangent equations	Unable to understand the parametric representation of curves or compute the tangent vector or tangent equation of a parametric curve
Achievement 3	In addition to understanding polar coordinates and polar equations, students will be able to calculate the length of the curve represented by the polar equation and the area enclosed	Able to understand polar coordinates and polar equations	Unable to understand polar coordinates or polar equations
Achievement 4	Able to calculate complex improper integrals	Able to compute simple improper integrals	Unable to compute simple improper integrals
Achievement 5	In addition to being able to calculate higher-order derivatives of simple functions, Maclaurin expansions, and Euler's formulas, the students will be able to calculate the radius of convergence of power series and quadratic approximations	Able to calculate using higher derivatives of simple functions, Maclaurin expansions, and Euler's formula	Unable to calculate using higher derivatives of simple functions, Maclaurin expansions, and Euler's formula

Assigned Department Objectives	
Fundamental Scientific Knowledge (A)	
Teaching Method	
Outline	Continuing from Mathematics A-2, students will learn about calculus, which is indispensable as basic knowledge for engineers. Simultaneously, they will hone their mathematical thinking and improve their mathematical education.
Style	The first half deals with the application of definite integrals and the methods of differentiation and integration of functions represented by parametric variables and polar coordinates. The second half deals with improper integrals and Maclaurin expansions.
Notice	This subject is a specialized basic subject and must be completed by the end of the fourth year. Additionally, the student cannot advance to the next grade if they incur an excessive number of absences.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Preparation for learning, outline of class, application of definite integral area (calculus 1§9 application of definite integral)	1
		2nd	Volume, velocity, and position	1
		3rd	Curve parametric representation (calculus 2 § 1 curve parametric representation and polar equation)	2
		4th	Parametric representation and differential method	2
		5th	Parametric representation and integration method	2
		6th	Cartesian and polar coordinates	3
		7th	Midterm examination	
		8th	Various curves	3
	2nd Quarter	9th	Polar equations and integration methods	3
		10th	Improper integrals (§2 Various integration methods)	4
		11th	Higher derivatives (§3 Expansion of functions) and power series	5
		12th	Taylor's theorem and Taylor expansion	5
		13th	Euler's formula	5
		14th	Maclaurin polynomials and function approximation	5
		15th	Final examination	
		16th	Return of examination	

Evaluation Method and Weight (%)

	Examination	Quiz, submission of assignments, and attendance status	Total
Subtotal	70	30	100
Basic Proficiency	70	30	100
Specialized Proficiency	0	0	0
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Mathematics A-3-2

Course Information			
Course Code	102340	Course Category	General / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Second Semester	Classes per Week	4
Textbook and/or Teaching Materials	高専テキストシリーズ　微分積分２　上野健爾[監修]　高専の数学教材研究会[編]（森北出版）、高専テキストシリーズ　微分積分２問題集　上野健爾[監修]　高専の数学教材研究会[編]（森北出版）		
Instructor			

Course Objectives

1. Calculate the partial derivative of a function of two variables.
2. Calculate extremal value problems (including conditional problems) of two-variable functions.
3. Understand and apply the implicit function theorem.
4. Understand the basics of the complex number plane.
5. Understand multiple integrals and be able to calculate them (including converting variables to polar coordinates).

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to calculate partial derivatives, tangent plane equations, and total derivatives of complex two-variable functions	Able to calculate partial derivatives, tangent plane equations, and total derivatives of simple two-variable functions	Unable to calculate partial derivatives, tangent plane equations, and total derivatives of simple two-variable functions
Achievement 2	Able to solve conditional extremal value problems in addition to being able to find the extrema of simple two-variable functions	Able to calculate the extrema of a simple two-variable function	Unable to calculate the extrema of a simple two-variable function
Achievement 3	Able to use the implicit function theorem to obtain the equation of the tangent to the curve in addition to being able to calculate implicit functions	Able to calculate implicit functions	Unable to calculate implicit functions
Achievement 4	Able to use de Moivre's theorem and understand simple figures and motions in the plane of complex numbers in addition to understanding the complex number plane and being able to perform calculations in polar form	Able to understand the complex number plane and perform calculations in polar form	Unable to understand the complex number plane or do polar form calculations
Achievement 5	Able to calculate the volume of solids by changing the order of integrals, double integrals with change of variables, and double integrals in addition to calculating simple double integrals	Able to calculate simple double integrals	Unable to calculate simple double integrals

Assigned Department Objectives

Fundamental Scientific Knowledge (A)

Teaching Method	
Outline	Following mathematics A-3-1, students learn calculus, which is indispensable as basic knowledge for engineers.
Style	In this lecture, students will learn differentiation and integration for two-variable functions. It also deals with the complex number plane.
Notice	This is a specialized basic course and must be completed by the end of the fourth year. Additionally, the student will not be able to advance to the next year if they incur an excessive number of absences.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Learning mindset, class outline, two-variable function (§4 Partial derivative)	1
		2nd	Partial derivatives, derivatives of composite functions, and partial derivatives	1
		3rd	Tangent plane, total derivatives, and approximations	1
		4th	Extremal values of two-variable functions (§5 Application of partial derivatives), methods of judging extremal values	2
		5th	Implicit differentiation method	3
		6th	Constrained extremal problem	2
		7th	Midterm examination	
		8th	Complex numbers, complex number plans (auxiliary print)	4
	4th Quarter	9th	Polar form, de Moivre's theorem	4
		10th	Figures and equations	4
		11th	Double integral (§6 Double integral)	4
		12th	Calculation of double integral by iterative integration	5
		13th	Variable conversion	5
		14th	Solid volume	5
		15th	Final examination	5
		16th	Return of examination	

Evaluation Method and Weight (%)

	Examination	Quiz, submission of assignments, and attendance status	Total
Subtotal	70	30	100
Basic Proficiency	70	30	100
Specialized Proficiency	0	0	0
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Mathematics B-3

Course Information			
Course Code	102370	Course Category	General / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	高専テキストシリーズ　線形代数（森北出版）、高専テキストシリーズ　線形代数問題集（森北出版）、高専テキストシリーズ　微分積分２（森北出版）、高専テキストシリーズ　微分積分２問題集（森北出版）		
Instructor			

Course Objectives

1. Understand the properties of determinants and be able to calculate and apply them.
2. Solve simultaneous linear equations using basic transformations of matrices and calculate inverse matrices.
3. Understand, calculate, and apply linear transformation.
4. Understand and find the eigenvalues and eigenvectors of matrices.
5. Solve basic first-order differential equations.
6. Solve basic second-order differential equations.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand the properties of determinants and apply them to development problems	Able to understand the properties of determinants and calculate determinants	Unable to calculate determinants
Achievement 2	Able to solve various linear equation systems using basic transformations of matrices	Able to find solutions and inverse matrices of ternary systems of linear equations using basic transformations of matrices	Unable to find solutions and inverse matrices of ternary systems of linear equations using basic transformations of matrices
Achievement 3	Able to apply linear transformations on the transformation of various plane figures	Able to understand linear transformations and perform basic calculations	Unable to understand linear transformations or perform basic calculations
Achievement 4	Able to explain the properties and meanings of eigenvalues and eigenvectors and diagonalize square matrices	Able to calculate eigenvalues and eigenvectors of second-order and third-order square matrices	Unable to calculate eigenvalues and eigenvectors of second-order and third-order square matrices
Achievement 5	Able to solve complicated first-order differential equations and apply first-order differential equations to problems in physics and engineering	Able to understand differential equations and solve basic separable-variable, first-order differential equations	Unable to solve basic first-order differential equations
Achievement 6	Able to apply second-order differential equations to physics and engineering problems	Able to solve basic constant coefficient second-order linear differential equations	Unable to solve basic constant coefficient second-order linear differential equations

Assigned Department Objectives

Fundamental Scientific Knowledge (A)

Teaching Method

Outline	Students will learn the basics of linear algebra and differential equations, which is basic knowledge for engineers.

Style	Classes will be conducted in a lecture format, and exercises will be conducted as appropriate. Moreover, assignments will be given as necessary. In the first half, we will learn how to calculate matrices and determinants and learn about linear transformations, eigenvalues, and diagonalization of matrices. In the second half, we will learn first- and second-order differential equations. Based on the separable form of variables, we will study the method of solving linear differential equations.
Notice	This is a specialized basic course and must be completed by the end of the fourth year. Additionally, students will not be allowed to proceed to the next year if they incur an excessive number of absences. If you advance to a higher grade without earning credits, you will need to take a confirmation test to receive credit recognition. Students cannot advance to the fifth year unless they pass the confirmation test.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Learning mindset and ("Linear Algebra" section 4 determinant) determinant of the product of matrices	1
		2nd	Determinant expansion	1
		3rd	Calculating inverse matrix with cofactor matrix	1
		4th	(Section 5 Basic transformations and their applications) Solving simultaneous linear equations by basic transformations	2
		5th	Calculation of inverse matrix by basic transformation	2
		6th	Rank of matrix	2
		7th	Midterm examination	
		8th	Classification of solutions to systems of linear equations	2
	2nd Quarter	9th	Solution of homogenous system of linear equations	2
		10th	Linear independence and dependence of vectors	2
		11th	(Section 6 Linear transformation) Linear transformation and its representation matrix	3
		12th	Various linear transformations	3
		13th	Composite transformation and inverse transformation	3
		14th	Exercises	2,3
		15th	Final examination	
		16th	Return of examination	
	3rd Quarter	1st	(Section 7 Eigenvalues and diagonalization of square matrices) Eigenvalues and eigenvectors	4
		2nd	Eigenvalues and eigenvectors of a quadratic square matrix	4
		3rd	Eigenvalues and eigenvectors of a cubic square matrix	4
		4th	Matrix diagonalization	4
		5th	("Differential Integral 2" Section 7 First-order differential equation) Differential equation	5
		6th	Separate variables	5
		7th	Midterm examination	
		8th	Linear differential equation (1)	5

2nd Semester	4th Quarter	9th	Linear differential equation (2)	5
		10th	Differential equations of homogeneous form	5
		11th	(Section 8 Second-order differential equation) Homogeneous second-order linear differential equation	6
		12th	Constant coefficient homogeneous second-order linear differential equation	6
		13th	Inhomogeneous second-order linear differential equation	6
		14th	Inhomogenous linear differential equation with constant	6
		15th	Final examination	
		16th	Return of examination	

Evaluation Method and Weight (%)

	Examination	Quiz, submission of assignments, and attendance status	Total
Subtotal	70	30	100
Basic Proficiency	70	30	100
Specialized Proficiency	0	0	0
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Health and Physical Education 3

Course Information

Course Code	101551	Course Category	General / ompulsory
Class Format	Skill	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	アクティブスポーツ総合版　（大修館書店）運動と健康の科学　（鈴木製本所）		
Instructor			

Course Objectives

1. Understand the characteristics and rules of each sport
2. Acquire the skills of the exercise items used in the teaching materials
3. Understand the way people think about health
4. Develop the habit of exercising voluntarily according to one's physical strength
5. Plan, manage, and reflect on games, etc., according to the athletic ability of each group

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand the characteristics and rules of each sport	Able to understand the characteristics and rules of each sport	Unable to understand the rules of each sport
Achievement 2	Able to express basic skills and apply them in the game	Able to express basic skills	Unable to express basic skills
Achievement 3	Able to understand and apply what is necessary for a healthy life	Able to understand what is necessary for a healthy life	Unable to understand what is necessary for a healthy life
Achievement 4	Able to evaluate one's physical strength and improve it	Able to evaluate one's own physical strength	Unable to understand one's own physical strength
Achievement 5	Able to plan, operate, and reflect on games, etc., according to athletic ability	1. Able to understand the characteristics and rules of each sport 2. Able to acquire the skills of the exercise items used in the teaching materials 3. Able to understand the way people think about health 4. Able to develop the habit of exercising voluntarily according to one's physical strength 5. Able to manage games, etc. according to the athletic ability of each group.	1. Unable to understand the characteristics and rules of each sport 2. Unable to acquire the skills of the exercise items used in the teaching materials 3. Unable to understand the way people think about health 4. Unable to develop the habit of exercising voluntarily according to one's physical strength 5. Unable to manage games, etc. according to the athletic ability of each group.

Assigned Department Objectives

Culture (D)

Teaching Method

Outline	Develop competitive and cooperative experience and an attitude of fairness through games in each sport. Consideration is given so that there is no difference in the amount of exercise due to the division into small groups (groups/teams). Physical training focuses on the improvement of whole-body endurance.
Style	Students simultaneously learn practical skills and rules; develop classes while having students make combinations and rules in each situation so that they can independantly manage competitions. Preparations will be communicated in the previous class.

Notice	・Attend in gym clothes or clothes and shoes suitable for exercise during practical skills ・Bring water for rehydration ・If you are sick or injured, please inform us of the reason and condition in advance ・In the case of a long-term observation or absence, please notify the teacher through your homeroom teacher ・Make sure you are in good physical condition to attend the practice ・Prepare textbooks and notebooks for the science of exercise and health.

Characteristics of Class / Division in Learning

☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Guidance	1・2・3・4・5
		2nd	Volleyball Improving group skills, understanding situational judgment and one's role during games	1・2
		3rd	Softball Cultivating situational judgment and cooperative play during games, team building (suitability by position), and understanding one's role	1・2
		4th	Volleyball Improving group skills, understanding situational judgment and one's role during games	1・2
		5th	Sports test	1・2・3
		6th	Sports test	1・2・3
		7th	Midterm examination	
		8th	The Science of Exercise and Health Creating individual fitness training plans based on sports test results	1・2
	2nd Quarter	9th	Volleyball Improving group skills, understanding situational judgment and one's role during games	1・2
		10th	Softball Cultivating situational judgment and cooperative play during games, team building (suitability by position), and understanding one's role	1・2
		11th	Volleyball Improving group skills, understanding situational judgment and one's role during games	1・2・3・4・5
		12th	Softball Cultivating situational judgment and cooperative play during games, team building (suitability by position), and understanding one's role	1・2・3・4・5
		13th	Volleyball Improving group skills, understanding situational judgment and one's role during games	1・2・3・4・5
		14th	Softball Cultivating situational judgment and cooperative play during games, team building (suitability by position), and understanding one's role	1・2・3・4・5
		15th	Final examination	
		16th		

2nd Semester	3rd Quarter	1st	Track and field (running) Understanding and acquiring techniques in sprinting and measurement	1・2・4
		2nd	Track and field (running) Understanding and acquiring techniques in sprinting and measurement	1・2・4
		3rd	Basketball Improving individual skills (shooting) and group skills, games	1・2・3
		4th	Endurance running/soccer Understanding and acquiring basic individual skills, group tactics, team tactics, games	1・2・3
		5th	Basketball Improving individual skills (shooting) and group skills, games	1・2・3
		6th	Endurance running/soccer Understanding and acquiring basic individual skills, group tactics, team tactics, games	1・2・3
		7th	Midterm examination	
		8th	Endurance running/soccer Understanding and acquiring basic individual skills, group tactics, team tactics, games	1・2・3
	4th Quarter	9th	Basketball Improving individual skills (shooting) and group skills, games	1・2・3
		10th	Endurance running/soccer Understanding and acquiring basic individual skills, group tactics, team tactics, games	1・2・3・4・5
		11th	Basketball Improving individual skills (shooting) and group skills, games	1・2・3・4・5
		12th	Endurance running/soccer Practical test, game	1・2・3・4・5
		13th	Basketball Practical test, game	1・2・3・4・5
		14th	The Science of Exercise and Health Understanding how to improve muscle strength and endurance and learning about the effects of drugs on the body	3
		15th	Final examination	
		16th		

Evaluation Method and Weight (%)

	Practical skill	Level of understanding of health	Behavior	Total
Subtotal	60	10	30	100
Basic Proficiency	60	0	10	70
Specialized Proficiency	0	10	0	10
Cross Area Proficiency	0	0	20	20

Niihama College	Year	2023	Course Title	Health and Physical Education 4

Course Information			
Course Code	101562	Course Category	General / Compulsory
Class Format	Skill	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	学生の健康科学（鈴木製本所）		
Instructor			

Course Objectives

1. Acquire the individual and collective skills of the sports used in the teaching materials.
2. Improve the student's daily life by helping them understand their physical strength.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	For the exercise items used in the teaching materials, develop advanced skills and demonstrate them in games.	Demonstrate basic skills in the exercise items used in teaching materials.	Insufficiently acquired basic skills for the exercise items used in teaching materials.
Achievement 2	Able to evaluate their physical fitness through the results of the sports test and reflect it by improving their daily life.	Able to evaluate their physical fitness through the results of the sports test.	Unable to understand the necessity of physical strength improvement for a healthy lifestyle.

Assigned Department Objectives

Culture (D)

Teaching Method

Outline	・Acquire skills that can be used in social physical education in the future from the perspective of lifelong learning ・Cultivate a fair attitude, active participation, and voluntary activities ・Gain an objective understanding of their physical strength and understanding of improvement methods
Style	・By dividing students into small groups (groups/teams), absence of bias in the degree of participation is ensured. ・Voluntarily plan and operate.
Notice	・Wear appropriate attire for exercising (gym clothes, jerseys, sports shoes). ・Bring water for rehydration ・Please let us know in advance if you are sick or injured. ・In the case of long-term visits or absences, a medical certificate must be submitted. ・Good physical condition is required for attendance.

Characteristics of Class / Division in Learning			
☑ Active Learning	□ Aided by ICT	□ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Explanation of guidance/planning and management methods	1・2
		2nd	Sports test	2
		3rd	Sports test	2
		4th	Health (1) Knowing the current state of one's physical fitness through the results of sports tests	2
		5th	Softball/tennis Basic Practice/game	1・2
		6th	Volleyball/badminton/table tennis Basic Practice/game	1・2
		7th	Midterm examination period	
		8th	Volleyball/badminton/table tennis Basic Practice/game	1・2
	2nd Quarter	9th	Softball/tennis Basic Practice/game	1・2
		10th	Volleyball/badminton/table tennis Basic Practice/game	1・2
		11th	Softball/tennis Basic Practice/game	1・2
		12th	Volleyball/badminton/table tennis Basic Practice/game	1・2
		13th	Swimming	1・2
		14th	Health (2) Concept of health	2
		15th	Final examination period	
		16th		
2nd Semester	3rd Quarter	1st	Basketball/badminton/table tennis Basic Practice/game	1・2
		2nd	Soccer/tennis Basic practice/game	1・2
		3rd	Basketball/badminton/table tennis Basic Practice/game	1・2
		4th	Soccer/tennis Basic practice/game	1・2
		5th	Basketball/badminton/table tennis Basic Practice/game	1・2
		6th	Soccer/tennis Basic practice/game	1・2
		7th	Midterm examination period	
		8th	Health (3) Having a healthy diet and a healthy life	2
		9th	Basketball/badminton/table tennis Basic Practice/game	1・2
		10th	Soccer/tennis Basic practice/game	1・2

	4th Quarter	11th	Basketball/badminton/table tennis Basic Practice/game	1・2
		12th	Soccer/tennis Basic practice/game	1・2
		13th	Basketball/badminton/table tennis Practical skills test	1・2
		14th	Soccer/tennis Practical skill test	1・2
		15th	Final examination period	
		16th		

Evaluation Method and Weight (%)

	Practical skill	Understanding of health content	Behavior	Total
Subtotal	60	10	30	100
Basic Proficiency	60	0	10	70
Specialized Proficiency	0	10	0	10
Cross Area Proficiency	0	0	20	20

Niihama College	Year	2023	Course Title	Budo

Course Information			
Course Code	101521	Course Category	General / Elective
Class Format	Skill	Credits	Academic Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives
Learning about Japanese athletic culture, mainly kendo, as well as aspects of the wisdom, etiquette, manners, and conduct arising from that lifestyle.

Rubric			
	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can apply the wisdom, etiquette, manners, and conduct arising from this lifestyle.	Knows the wisdom, etiquette, manners, and conduct arising from this lifestyle.	Does not understand the wisdom, etiquette, manners, and conduct arising from this lifestyle.
Achievement 2	Can perform budo techniques in bouts with others	Can understand budo techniques and practice solo	Does not understand budo techniques

Assigned Department Objectives
Culture (D)

Teaching Method	
Outline	To learn about the origins of budo and the institutional innovation of its techniques and practicing the manners, etiquette, and conduct that were born from the lifestyle of the time by experiencing the Japanese martial art of budo (as designated by the Ministry of Education, Culture, Sports, Science and Technology) and understanding and imagining the background of the time.
Style	Learn about 9 martial arts designated by the Ministry of Education, Culture, Sports, Science and Technology; and learn about the history of martial arts and confirm and acquire its techniques through learning the wisdom, etiquette, manners, and conduct arising from this lifestyle.
Notice	Experience the athletic culture of budo

Characteristics of Class / Division in Learning			
☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	Experience kendo, judo, and jukendo	1
		2nd	Experience karate, aikido, and shorinji kempo	1
		3rd	Experience kyudo, sumo, and naginata	1
		4th	Experience the manners, etiquette, and conduct (mainly Osagawara style)	1
		5th	Learn the basic movements of kendo (stance, handling a shinai, defensive movements)	1
		6th	Learn the basic movements of kendo (stance, handling a shinai, defensive movements)	1
		7th	Learn the basic movements of kendo (stance, handling a shinai, defensive movements)	1
		8th	Learn the basic movements of kendo (stance, handling a shinai, defensive movements)	1
	2nd Quarter	9th	Learn the individual movements of kendo (handling a shinai, defensive movements, striking)	1
		10th	Learn kendo movements against opponents (striking: head, gauntlet, plastron, throat)	1
		11th	Learn kendo movements against opponents (striking: head, gauntlet, plastron, throat)	1
		12th	Learn kendo movements against opponents (striking: head, gauntlet, plastron, throat)	1
		13th	Learn kendo movements against opponents (Practice)	1
		14th	Learn basic movements of aikido (stance, defensive movements)	1
		15th	Learn basic movements of aikido (stance, defensive movements)	1
		16th	Learn kendo: Match Learn aikido: against opponents	1

Evaluation Method and Weight (%)

	Technique	Knowledge	Use (Manners, etc.)				Total
Subtotal	30	30	40	0	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	English 3

Course Information			
Course Code	101750	Course Category	General / Compulsory
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	Writing from Within Level 1［C. Kelly and A. Gargagliano著, Cambridge University Press］		
Instructor			

Course Objectives

1. Accurately understand information written in English.
2. Organize the information one wants to convey at the level of words and phrases.
3. Write appropriate English sentences using learned sentence patterns and grammatical items.
4. Use phrases and expressions necessary to express one's thoughts and feelings.
5. Write English sentences that are understood by the reader according to the situation and purpose.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
1. Accurately understand information written in English.	Able to accurately understand information written in English without using a dictionary.	Able to accurately understand information written in English while using a dictionary.	Unable to understand information written in English.
2. Organize the information one wants to convey at the level of words and phrases.	Able to organize the information one wants to convey at the level of words and phrases without using a dictionary	Able to organize the information you want to convey at the level of words and phrases while using a dictionary	Unable to organize the information one wants to convey at the level of words or phrases.
3. Write appropriate English sentences using learned sentence patterns and grammatical items.	Able to write appropriate English sentences using learned sentence patterns and grammatical items without using reference books.	Able to write appropriate English sentences using learned sentence patterns and grammatical items while using reference books.	Unable to use previously learned sentence patterns and grammatical items to write in English.
4. Use phrases and expressions necessary to express one's thoughts and feelings.	Able to use various phrases and expressions to express one's thoughts and feelings.	Able to use some phrases and expressions necessary to convey one's thoughts and feelings.	Unable to use the words and expressions necessary to express one's thoughts and feelings.
5. Write English sentences that are understood by the reader according to the situation and purpose.	Able to write English that is easy for the reader to understand, in line with the situation and purpose.	Able to write sentences in English that match the situation and purpose.	Unable to write sentences in English that match the situation and purpose.

Assigned Department Objectives

Communication Skill (E)

Teaching Method	
Outline	Using texts on familiar topics, learn the structure of sentences and appropriate vocabulary and phrases, and cultivate the ability to accurately express the information you want to convey in English.
Style	According to the text, select a topic and check sentence structure, vocabulary, and phrases. Create an English paragraph of about 100 words about yourself and submit it as an assignment each time. Individual efforts will be the focus, but we will ask for comments in various ways to deepen understanding.

Notice	Related courses: English 1、English 2A、English 2B、English Conversation 1、English Conversation 2

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Introduction	
		2nd	Unit 1: Who am I?	1,2,3,4,5
		3rd	Unit 2: An important place	1,2,3,4,5
		4th	Unit 3: An ideal partner	1,2,3,4,5
		5th	Unit 4: My favorite photo	1,2,3,4,5
		6th	Unit 5: My seal	1,2,3,4,5
		7th	Unit 6: Party time	1,2,3,4,5
		8th	Second semester midterm examination	
	4th Quarter	9th	Unit 7: Thank-you note	1,2,3,4,5
		10th	Unit 8: Movie review	1,2,3,4,5
		11th	Unit 9: Friendship	1,2,3,4,5
		12th	Unit 10: Superhero powers	1,2,3,4,5
		13th	Unit 11: Advertisement	1,2,3,4,5
		14th	Unit 12: Lessons learned	1,2,3,4,5
		15th	General review	
		16th	Year-end examination	

Evaluation Method and Weight (%)

	Examination	Presentation/Assignment		Total
Subtotal	60	40	0	100
Basic Proficiency	60	40	0	0

Niihama College	Year	2023	Course Title	Technical English 1

Course Information

Course Code	101760	Course Category	General / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	・FACTBOOK English Logic and Expression Ⅰ（桐原書店） ・FACTBOOK English Logic and Expression Ⅰ マイノート ・DUO 3.0（アイシーピー）		
Instructor			

Course Objectives

1. Gain confidence in communicating in English.
2. Increase the number of topics on which they can express an opinion in English.
3. Increase the number of words and grammar that can be output accurately.
4. Work together in a group to tackle a task.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to work actively on communication issues in and out of class	Able to work on communication issues in and out of class	Unable to address communication issues adequately in and out of class
Achievement 2	Able to express an opinion logically on various topics	Able to express an opinion logically on various topics	Unable to express an opinion
Achievement 3	Able to use learned vocabulary and grammar appropriately	Able to use learned vocabulary and grammar	Unable to use learned vocabulary and grammar
Achievement 4	Able to work collaboratively and successfully on group assignments and presentations	Able to work on assignments and presentations in groups	Unable to work collaboratively on group assignments or presentations

Assigned Department Objectives

Communication Skill (E)

Teaching Method

Outline	The aim of this course is to raise English skills from the level of "understanding" to that of "use."
Style	In class, students work on communication tasks using textbooks. Outside of class, students are asked to upload their assignments on speaking. The quizzes and exams will assess your comprehension of the content and your writing output.
Notice	Please work hard on each assignment. Review the content of the class; if you do not understand something, take action on your own. Students must be actively involved in all activities.

Characteristics of Class / Division in Learning

☑ Active Learning	☑ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	Introduction to the course	1,2,3,4
		2nd	Unit 1 Smart home, smart city	1,2,3,4
		3rd	Unit 1 Smart home, smart city	1,2,3,4
		4th	Unit 1 Smart home, smart city	1,2,3,4
		5th	Unit 2 History and future of our town	1,2,3,4
		6th	Unit 2 History and future of our town	1,2,3,4
		7th	Exam week	
		8th	Unit 2 History and future of our town	1,2,3,4
	2nd Quarter	9th	Unit 4 Water supporting our lives	1,2,3,4
		10th	Unit 4 Water supporting our lives	1,2,3,4
		11th	Unit 4 Water supporting our lives	1,2,3,4
		12th	Unit 6 How can we become more health-conscious?	1,2,3,4
		13th	Unit 6 How can we become more health-conscious?	1,2,3,4
		14th	Unit 6 How can we become more health-conscious?	1,2,3,4
		15th	Exam	2,3
		16th	Review	1,2,3,4
2nd Semester	3rd Quarter	1st	Unit 7 How many clothes do you buy?	1,2,3,4
		2nd	Unit 7 How many clothes do you buy?	1,2,3,4
		3rd	Unit 7 How many clothes do you buy?	1,2,3,4
		4th	Unit 8 How do you decide which products to buy?	1,2,3,4
		5th	Unit 8 How do you decide which products to buy?	1,2,3,4
		6th	Unit 8 How do you decide which products to buy?	1,2,3,4
		7th	Exam week	
		8th	Unit 9 A variety of ways to improve your English	1,2,3,4
	4th Quarter	9th	Unit 9 A variety of ways to improve your English	1,2,3,4
		10th	Unit 9 A variety of ways to improve your English	1,2,3,4
		11th	Unit 10 How can we become foreigner-friendly?	1,2,3,4
		12th	Unit 10 How can we become foreigner-friendly?	1,2,3,4
		13th	Unit 10 How can we become foreigner-friendly?	1,2,3,4
		14th	Final presentations	1,2,3,4
		15th	Exam	2,3
		16th	Review	1,2,3,4

Evaluation Method and Weight (%)				
	Examination	Presentation	Assignment	Total
Subtotal	60	20	20	100
Basic Proficiency	60	20	20	100

Niihama College	Year	2023	Course Title	English Conversation 2

Course Information

Course Code	101770	Course Category	General / Compulsory
Class Format	Seminar	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials			
Instructor			

Course Objectives

1. Show an improvement in their English skills from 1st year
2. Make students communicate at a more fluent level
3. Make students understand communication differences between Japan and the world
4. Demonstrate speaking ability

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Uses proper vocabulary and grammar and not just vocabulary	Communicates occasionally. Meaning is understood but many errors	Remain silent
Achievement 2	Uses proper sentence construction to express themselves appropriately	Communicates in broken English. Meaning can be understood	Remain silent
Achievement 3	Uses proper sentence construction to express themselves appropriately	Can answer simply but should speak in more depth	Remain silent
Achievement 4	Show good ability, animation and presences in presentations	Does presentations at a minimum level	Does not do presentations

Assigned Department Objectives

Communication Skill (E)

Teaching Method

Outline	The students in this class are expected to show an improvement in their English skills from the 1st year. The goal of this class is to make students communicate at a more fluent level by using proper sentence construction and expressing themselves appropriately.
Style	The class is designed so that students will talk about both school experiences as well as life experiences. Small group work as well as presentations will be used.
Notice	Students are required to speak English as fluently as possible. Students are required to try to use proper sentences and express themselves.

Characteristics of Class / Division in Learning

☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	Reduced Speech Introduction & Instructions	1,2,3,4
		2nd	Expansion Work & Self-Introduction Presentations	1,2,3,4
		3rd	TOEIC Review	1,2,3,4
		4th	Grammar Question Review 1	1,2,3,4
		5th	Conversation Questions and Present Perfect 1 - Experience	1,2,3,4
		6th	Present & Past Tense	1,2,3,4
		7th	Exam week	
		8th	Present Tense - Routines	1,2,3,4
	2nd Quarter	9th	Present & Past Tense - Used to, Not Anymore	1,2,3,4
		10th	Numbers 1	1,2,3,4
		11th	Numbers 2	1,2,3,4
		12th	Future Tense 1 - Modal Verbs of Prediction	1,2,3,4
		13th	Future Tense 2 - wanna,gonna,Hafta - Reduced Speech in Conversation	1,2,3,4
		14th	Describing People & Places Be / Have Verbs	1,2,3,4
		15th	Exam	1,2,3,4
		16th	How to Improve Niihama Kosen (Presentations)	1,2,3,4

Evaluation Method and Weight (%)				
	English conversational skill	Behavior	Assignment	Total
Subtotal	50	30	20	100
Basic Proficiency	50	30	20	100

Niihama College	Year	2023	Course Title	Technical English 2

Course Information			
Course Code	101780	Course Category	General / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	Our World Today　Adam Murray　Anderson Passos （南雲堂）　DUO3.0 （アイ・シー・ビー）		
Instructor			

Course Objectives

1. Improve the vocabulary required to read scientific English texts.
2. Understand and apply basic grammar and syntax.
3. Read short and intensive English sentences.
4. Acquire basic English writing skills.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand 80% or more of the vocabulary required to read scientific English texts.	Able to understand 60% or more of the vocabulary required to read scientific English texts.	Unable to understand more than 60% of the vocabulary required to read scientific English texts.
Achievement 2	Able to understand and apply more than 80% of basic grammar and syntax.	Able to understand and apply more than 60% of basic grammar and syntax.	Unable to understand and apply more than 60% of basic grammar and syntax.
Achievement 3	Able to read short English sentences quickly and intensively	Able to read simple English.	Unable to read simple English.
Achievement 4	Able to write scientific English sentences accurately.	Able to write English sentences related to science.	Unable to write English sentences about science.

Assigned Department Objectives

Communication Skill (E)

Teaching Method

Outline	The students read articles on climate change, energy, garbage, population growth, pollution, water, deforestation, power generation, etc. In addition to cultivating the ability to accurately read scientific content in English, the course also provides clues for future research methods.
Style	CDs are used during classes to help students understand the English texts.
Notice	Bring a dictionary and look up words you do not understand.

Characteristics of Class / Division in Learning

☐ Active Learning	☑ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	Introduction ・ Unit 2 Climate Change	1,2,3,4
		2nd	Unit 2 Climate Change	1,2,3,4
		3rd	Unit 3 Energy	1,2,3,4
		4th	Unit 3 Energy	1,2,3,4
		5th	Unit 1 Introduction to Environmental Issues	1,2,3,4
		6th	Unit 1 Introduction to Environmental Issues	1,2,3,4
		7th	Midterm examination	
		8th	Unit 4 Waste	1,2,3,4
	2nd Quarter	9th	Unit 4 Waste	1,2,3,4
		10th	Unit 5 Unit 1-4 Review	1,2,3,4
		11th	Unit 6 Population growth	1,2,3,4
		12th	Unit 6 Population growth	1,2,3,4
		13th	Unit 7 Pollution	1,2,3,4
		14th	Unit 7 Pollution	1,2,3,4
		15th	Final examination	
		16th		
2nd Semester	3rd Quarter	1st	Unit 8 Water	1,2,3,4
		2nd	Unit 8 Water	1,2,3,4
		3rd	Unit 9 Deforestation	1,2,3,4
		4th	Unit 9 Deforestation	1,2,3,4
		5th	Unit 10 Unit 6-9 Review	1,2,3,4
		6th	Unit 11 Hydroelectricity	1,2,3,4
		7th	Midterm examination	
		8th	Unit 11 Hydroelectricity	1,2,3,4
	4th Quarter	9th	Unit 12 Solar Panels	1,2,3,4
		10th	Unit 12 Solar Panels	1,2,3,4
		11th	Unit 13 Wind Turbines	1,2,3,4
		12th	Unit 13 Wind Turbines	1,2,3,4
		13th	Unit 14 Nuclear Energy	1,2,3,4
		14th	Unit 14 Nuclear Energy	1,2,3,4
		15th	Final examination	
		16th		

Evaluation Method and Weight (%)			
	Examination	Presentation/Deliverables/Assignment/Quiz	Total
Subtotal	70	30	100
Basic Proficiency	70	30	100

Niihama College	Year	2023	Course Title	Current English

Course Information			
Course Code	101790	Course Category	General / Compulsory
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	Meet the World - English through Newspapers 2022 若有保彦編著（成美堂） Duo 3.0 （アイ・シー・ピー）		
Instructor			

Course Objectives

1 Acquiring the ability to read articles in English newspapers quickly and accurately and to understand their contents.
2 Learning phrases and vocabulary commonly used in English newspapers.
3 Gaining interest in various issues occurring in society.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can read English quickly and accurately, and understand the substance	Can generally read English accurately, and generally understand the substance	Cannot read English accurately or understand the substance
Achievement 2	Has acquired sufficient mastery	Has acquired general mastery	Has not mastered it
Achievement 3	Is highly interested and can use it as a reference in one's own life	Develops interest and awareness in previously unknown issues	Shows little or no interest

Assigned Department Objectives

Communication Skill (E)

Teaching Method

Outline	Students will cultivate the ability to understand English text quickly and accurately by reading articles on world affairs taken from English newspapers. The course will also arouse interest in and broaden perspectives on current world issues to deepen students' understanding as people who will soon become active members of society.
Style	Active class participation is encouraged, and explanations will be added to the lectures. Students are expected to go over the material to be covered in class in advance. Duo.3.0 will be used to improve vocabulary.
Notice	Students should prepare for class. (Look up the meanings of unfamiliar words, read the text, and understand the main idea.) Bring an English-Japanese dictionary to class. Make a habit of using Duo 3.0 to improve vocabulary. Related Subjects: English 1, English 2A, English 2B, International Comprehension

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Introduction, Unit 1 Self-made South Korean billionaires promise to give half way	1,2,3
		2nd	Unit 1 Self-made South Korean billionaires promise to give half way	1,2,3
		3rd	Unit 2 Treaty to eliminate nukes takes effect	1,2,3
		4th	Unit 2 Treaty to eliminate nukes takes effect	1,2,3
		5th	Unit 3 Lockdown-weary Malaysians get appetite for drive-in dining	1,2,3
		6th	Unit 3 Lockdown-weary Malaysians get appetite for drive-in dining	1,2,3
		7th	Mid-term Examination	
		8th	Unit 4 France to extend lifetime of old nuclear power plants	1,2,3
	2nd Quarter	9th	Unit 4 France to extend lifetime of old nuclear power plants	1,2,3
		10th	Unit 5 Captain: Passengers' letters supported crew	1,2,3
		11th	Unit 5 Captain: Passengers' letters supported crew	1,2,3
		12th	Unit 6 Black kings, but no politics - Murphy returns in Coming 2 America	1,2,3
		13th	Unit 6 Black kings, but no politics - Murphy returns in Coming 2 America	1,2,3
		14th	Unit 7 Learning as avatars may become new norm	1,2,3
		15th	Final Exam	
		16th		
2nd	3rd Quarter	1st	Unit 7 Learning as avatars may become new norm	1,2,3
		2nd	Unit 8 Online safaris, tours keep everyone safe	1,2,3
		3rd	Unit 8 Online safaris, tours keep everyone safe	1,2,3
		4th	Unit 9 Nippon Steel aims to achieve decarbonization by 2050	1,2,3
		5th	Unit 9 Nippon Steel aims to achieve decarbonization by 2050	1,2,3
		6th	Unit 10 Harvard astronomer argues that alien vessel paid us a visit	1,2,3
		7th	Mid-term Examination	
		8th	Unit 10 Harvard astronomer argues that alien vessel paid us a visit	1,2,3

Semester	4th Quarter	9th	Unit 11 Remnants of 'railway on the shore'	1,2,3
		10th	Unit 11 Remnants of 'railway on the shore'	1,2,3
		11th	Unit 12 AI to predict crowding at evacuation centers	1,2,3
		12th	Unit 12 AI to predict crowding at evacuation centers	1,2,3
		13th	Unit 13 U.S. seeks participation of Japan, 'Five Eyes' in 5G teams versus China	1,2,3
		14th	Unit 13 U.S. seeks participation of Japan, 'Five Eyes' in 5G teams versus China	1,2,3
		15th	Final Exam	
		16th		

Evaluation Method and Weight (%)

	Examination	Presentation, Submission, Assignment, Quiz	Total
Subtotal	70	30	100
Basic Proficiency	70	30	100

Niihama College	Year	2023	Course Title	Elementary German

Course Information

Course Code	104810	Course Category	General / Elective
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	ドライクラング　異文化理解のドイツ語　菅利恵他著 / アポロン独和辞典、根本道也他著、同学社		
Instructor			

Course Objectives

Purpose:
By learning basic German grammar, the aim is to acquire German as a second foreign language and understand a different culture.

Attainment target:
1 Understand and pronounce German sounds.
2 Acquire knowledge of basic German grammar.
3 Obtain knowledge from sentences written in German using a dictionary.
4 Exchange simple information in German using letters and sounds.
5 Understand German-speaking culture and be able to express opinions about it.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to read German sentences aloud with correct pronunciation	Able to read German sentences aloud but makes occasional mistakes	Unable to pronounce German words
Achievement 2	Have good understanding of German grammar	Able to understand grammar explanations in textbooks and solve exercises	Unable to understand the contents of the textbook or do the exercises
Achievement 3	Able to understand most German sentences using a dictionary	Able to read coherent sentences to some extent using a dictionary	Unable to use a dictionary and understand German sentences
Achievement 4	Able to have a simple conversation and convey information in German	Able to listen and answer simple questions in German	Unable to understand German
Achievement 5	Have good understanding of German-speaking culture and be able to convey opinions about it in Japanese	Understand German-speaking culture to some extent and be able to convey information about it in Japanese	Unable to understand German-speaking culture

Assigned Department Objectives

Culture (D)

Teaching Method	
Outline	Check basic German grammar item by item. Experience German-speaking culture.
Style	Check your grammar with textbooks and practice handouts. Practice speaking in groups or pairs.
Notice	Bring a dictionary with you during class. Actively participate in group work and pair work. Learning German and experiencing the culture of German-speaking countries can help you see things from a different perspective and broaden your interests. Students should study proactively so that it will lead to growth.

Characteristics of Class / Division in Learning			
☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Guidance/Pronunciation and greetings	1, 4
		2nd	Lesson 1 Self-introduction	1, 2, 3, 4, 5
		3rd	Lesson 1 Self-introduction	1, 2, 3, 4, 5
		4th	Lesson 1 Self-introduction	1, 2, 3, 4, 5
		5th	Lesson 2 Hobby/leisure	1, 2, 3, 4, 5
		6th	Confirmation Test, Lesson 2 Hobbies and Leisure	1, 2, 3, 4, 5
		7th	Midterm examination period	
		8th	Lesson 2 Hobby/leisure	1, 2, 3, 4, 5
	2nd Quarter	9th	Lesson 3 What to bring and what to eat	1, 2, 3, 4, 5
		10th	Lesson 3 What to bring and what to eat	1, 2, 3, 4, 5
		11th	Lesson 3 What to bring and what to eat	1, 2, 3, 4, 5
		12th	Lesson 4 Family and housing	1, 2, 3, 4, 5
		13th	Lesson 4 Family and housing	1, 2, 3, 4, 5
		14th	Lesson 4 Family and housing	1, 2, 3, 4, 5
		15th	Final examination	1, 2, 3, 4
		16th	Return of examination and review	1, 2, 3, 4
2nd Semester	3rd Quarter	1st	Lesson 5 Nature, mind, and body	1, 2, 3, 4, 5
		2nd	Lesson 5 Nature, mind, and body	1, 2, 3, 4, 5
		3rd	Lesson 5 Nature, mind, and body	1, 2, 3, 4, 5
		4th	Lesson 6 Town walk	1, 2, 3, 4, 5
		5th	Lesson 6 Town walk	1, 2, 3, 4, 5
		6th	Confirmation test and review	1, 2, 3, 4
		7th	Midterm examination period	
		8th	German culture	2, 3, 5 (Cross-cultural understanding)
	4th Quarter	9th	German culture, review	2, 3, 5 (Cross-cultural understanding)
		10th	Lesson 6 Town walk	1, 2, 3, 4, 5
		11th	Lesson 7 Transportation	1, 2, 3, 4, 5
		12th	Lesson 7 Transportation	1, 2, 3, 4, 5
		13th	Lesson 7 Transportation	1, 2, 3, 4, 5
		14th	Review	1, 2, 3, 4
		15th	Year-end examination	1, 2, 3, 4, 5
		16th	Return of examination and review	1, 2, 3, 4, 5

Evaluation Method and Weight (%)

	Examination	Confirmation	Tasks, etc.				Total
Subtotal	70	15	15	0	0	0	100
Basic Proficiency	70	15	15	0	0	0	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Elementary Chinese

Course Information			
Course Code	104820	Course Category	General / Elective
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Year-round	Classes per Week	2
Textbook and/or Teaching Materials	理系のための中国語入門（好文出版）		
Instructor			

Course Objectives

1. Master Chinese pronunciation.
2. Understand simple daily conversations.
3. Make simple daily conversations.
4. Read basic Chinese.
5. Write basic Chinese.
6. Understand a part of modern Chinese culture and society.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to pronounce accurately by combining Chinese consonants and vowels	Able to pronounce basic consonants and vowels	Unable to pronounce basic consonants and vowels
Achievement 2	Able to accurately understand simple daily conversations	Able to understand words used in simple daily conversations	Unable to understand words used in simple daily conversations
Achievement 3	Able to make simple daily conversations with correct pronunciation	Able to pronounce words used in simple daily conversations	Unable to speak the words used in simple daily conversations
Achievement 4	Able to translate basic Chinese into accurate Japanese grammatically	Able to understand the meaning of words used in basic Chinese	Unable to understand the meaning of words used in basic Chinese
Achievement 5	Able to write basic Chinese accurately and grammatically	Able to write basic Chinese words	Unable to write basic Chinese words
Achievement 6	Able to understand a part of the structure of modern Chinese culture and society	Able to understand the basics of modern Chinese culture and society	Unable to understand contemporary Chinese culture and society

Assigned Department Objectives

Culture (D)

Teaching Method

Outline	The goal is to help students master the basics of Chinese pronunciation, learn simple daily conversations, and, at the same time, help them understand modern Chinese culture and society.
Style	Follow the text.

Notice	Acquisition of correct pronunciation determines success or failure in Chinese. Read aloud before and after class. China has the greatest influence not only on Japan but also on the world, so it is essential to understand China. Please study actively. Please purchase the textbook. If you do not purchase the book, you will not be admitted to the course. A midterm examination will not be held during the exam period, as pronunciation and conversational skills will be assessed individually through oral exams.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semeste r	1st Quarter	1st	Guidance on China and Chinese	6
		2nd	Pronunciation Lesson 1 (four tones, pinyin, single vowels)	1
		3rd	Pronunciation Section 1/2 (double vowels/Nasal vowels)	1
		4th	Modern Taiwanese culture	6
		5th	Pronunciation Lesson 2 (consonants)	1
		6th	Pronunciation Section 3 (tone changes, etc.)	1
		7th	Midterm examination (pronunciation test)	1
		8th	Pronunciation review	1,2
	2nd Quarter	9th	Lesson 1 How many are there?	2,3,4,5
		10th	Lesson 1 How many are there?	2,3,4,5
		11th	Lesson 2 Today is April 20th.	2,3,4,5
		12th	Lesson 2 Today is April 20th.	2,3,4,5
		13th	Lesson 3 What day is tomorrow?	2,3,4,5
		14th	Lesson 3 What day is tomorrow?	2,3,4,5
		15th	Final examination	2,4,5
		16th	Return of examination Lesson 4 I will buy this.	2,3,4,5
2nd Semeste r	3rd Quarter	1st	Lesson 4 I will buy this.	2,3,4,5
		2nd	Lesson 5 Where is the toilet?	2,3,4,5
		3rd	Lesson 5 Where is the toilet? Lesson 6 How is the weather in Shanghai?	2,3,4,5
		4th	Lesson 6 How is the weather in Shanghai?	2,3,4,5
		5th	Modern Chinese Culture (1)	6
		6th	Lesson 7 I will be at work at 7:30 tomorrow. Introduce yourself in Chinese	2,3,4,5
		7th	Lesson 7 I will be at work at 7:30 tomorrow. Introduce yourself in Chinese	2,3,4,5
		8th	Second semester midterm exam (pronunciation/conversation exam)	1 ,4
	4th Quarter	9th	Modern Chinese Culture (2)	6
		10th	Lesson 8 I drank two bottles of beer.	2,3,4,5
		11th	Lesson 8 I drank two bottles of beer. Lesson 9 My brother is just watching TV.	2,3,4,5
		12th	Lesson 9 My brother is just watching TV.	2,3,4,5
		13th	Lesson 10 Have you ever been to Beijing?	2,3,4,5
		14th	Lesson 10 Have you ever been to Beijing? Lesson 11 She gave me a piece of chocolate.	2,3,4,5
		15th	Lesson 11 She gave me a piece of chocolate.	2,3,4,5
		16th	Final examination	2,4,5

Evaluation Method and Weight (%)							
	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	80	0	0	0	0	20	100
Basic Proficiency	80	0	0	0	0	20	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	English Conversation 3

Course Information			
Course Code	104711	Course Category	General / Elective
Class Format	Seminar	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	New Time to Communicate　南雲堂		
Instructor			

Course Objectives
1. Acquiring the basic vocabulary and expressions necessary for conversation, and being able to communicate in English.

Rubric			
	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can use the vocabulary and expressions learned in the textbook to communicate with their peers in English.	Demonstrates a willingness to communicate with peers in English.	Does not demonstrate a willingness to communicate with peers in English.

Assigned Department Objectives
Communication Skill (E)

Teaching Method	
Outline	The aim of this course is to improve students' English communication skills through the use of teaching materials focusing on speaking activities. The goal for this class is for students to actually speak and "use" English.
Style	Students will learn expressions useful for interacting in English and practice conversations. Students will then write an English composition and present it to their classmates.
Notice	To speak English, you need to practice speaking English. Let's have fun speaking English together!

Characteristics of Class / Division in Learning			
☑ Active Learning	□ Aided by ICT	□ Applicable to Remote Class	□ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semeste	1st Quarter	1st	Unit 1 Meeting People	1
		2nd	Unit 2 Getting to Know Your Classmates	1
		3rd	Unit 3 Talking About Classes	1
		4th	Unit 8 Talking About the Vacation	1
		5th	Unit 4 Talking About Your Daily Life	1
		6th	Unit 5 Talking About People - Personality	1
		7th	Mid-term exam	1
		8th	Speaking activities	1

Semester	2nd Quarter	9th	Unit 6 Talking About People - Appearance	1
		10th	Unit 7 Talking About Last Weekend	1
		11th	Unit 10 Talking About Foods and Recipes	1
		12th	Unit 11 Talking About Travel	1
		13th	Unit 12 Talking About Hometowns	1
		14th	Unit 14 Talking About Future Plans	1
		15th	End-term exam	1
		16th	Speaking activities	1

Evaluation Method and Weight (%)			
	Examination	Assignment	Total
Subtotal	50	50	100
Basic Proficiency	50	50	100

Niihama College	Year	2023	Course Title	German Conversation

Course Information			
Course Code	104850	Course Category	General / Elective
Class Format	Seminar	Credits	school Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	アポロン独和辞典、根本道也他著、同学社		
Instructor			

Course Objectives

Objectives:
Acquiring the ability to live in a German-speaking country for a short time using the German language.
Attainment Objectives:
1. Learning German vocabulary for familiar topics.
2. Communicating about oneself in German.
3. Listening to German conversations about familiar topics.
4. Participating in conversations in German about the studied topics.
5. Understanding the culture of German-speaking countries.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Has acquired sufficient German vocabulary on familiar topics.	Has some knowledge of German vocabulary on familiar topics.	Has no knowledge of German vocabulary on familiar topics.
Achievement 2	Can communicate correctly about oneself in German.	Can give a simple self-introduction in German.	Cannot introduce oneself in German.
Achievement 3	Can accurately understand conversations in German about familiar topics.	Can understand conversations in German about familiar topics to a certain degree.	Cannot understand conversations in German about familiar topics.
Achievement 4	Can understand and accurately answer questions in German.	Can understand and answer questions in German.	Cannot understand questions in German.
Achievement 5	Can fully understand the culture of German-speaking countries and express opinions about it in Japanese.	Can understand the culture of German-speaking countries to some extent and communicate information in Japanese.	Cannot understand the culture of German-speaking countries.

Assigned Department Objectives

Culture (D)

Teaching Method	
Outline	Students will practice listening comprehension and conversations while reviewing basic grammar to develop the ability to live in a German-speaking area for a short period of time using German. They will also learn about German culture and customs.
Style	Students will use printed materials. They will also use CDs to practice listening comprehension. Conversation practice will be conducted in pairs or groups.
Notice	Please bring your own dictionary.

Characteristics of Class / Division in Learning			
☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Guidance/Pronunciation and greetings	1
		2nd	Introducing yourself (Present tense of verbs)	1,2
		3rd	Asking about people you've just met (Interrogative pronouns)	1,2,3,4
		4th	Asking details about a resume (Yes-or-no questions)	1,2,3,4,5
		5th	Asking about appointments (Expressions of time)	1,2,3,4,5
		6th	Communicating plans review	1,2,3,4,5
		7th	Mid-term examination	
		8th	Reading leaflets and emails (definite and indefinite articles), listening to German music	1,3,4,5
	2nd Quarter	9th	Listening to the day's events (Auxiliary verbs)	1,3,4,5
		10th	Shopping (Negative and possessive articles)	1,3,4,5
		11th	German expressions related to vehicles	1,3,4,5
		12th	German expressions related to food	1,3,4,5
		13th	Discussing plans related to a German study trip	1,5
		14th	Presentation about the German Study trip plan	1,5
		15th	Final Exam	1,2,3,4,5
		16th	Review	1,2,3,4,5

Evaluation Method and Weight (%)

	Examination	Presentation/					Total
Subtotal	60	40	0	0	0	0	100
Basic Proficiency	60	40	0	0	0	0	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Chinese Conversation

Course Information			
Course Code	104860	Course Category	General / Elective
Class Format	Seminar	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	台湾華語でぐるっと台湾めぐり		
Instructor			

Course Objectives
1. Learning Taiwanese Mandarin (Taiwanese Chinese) 2. Understanding contemporary Taiwanese culture

Rubric			
	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Sufficiently mastered Taiwanese Chinese	Learned a certain degree of Taiwanese Chinese	Did not learn Taiwanese Chinese
Achievement 2	Gained in-depth understanding of contemporary Taiwanese culture	Achieved a certain degree of understanding of contemporary Taiwanese culture	Does not understand contemporary Taiwanese culture

Assigned Department Objectives
Culture (D)

Teaching Method	
Outline	Taiwan is a popular destination for Japanese people seeking to enjoy convenient overseas travel. This course teaches students Taiwanese Mandarin (Taiwanese Chinese) and Taiwanese culture so that they may enjoy their travel in Taiwan.
Style	Follow the textbook. Part of the course will be conducted in collaboration with the National United University of Taiwan.
Notice	Students are expected to engage proactively in conversation.

Characteristics of Class / Division in Learning			
☑ Active Learning	☑ Aided by ICT	☑ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semeste	1st Quarter	1st	Guidance: So different! Taiwanese Chinese and Mainland Chinese	1,2
		2nd	Vocal Practice	1,2
		3rd	Keelung, Northern Taiwan	1,2
		4th	Taipei, Northern Taiwan	1,2
		5th	New Taipei, Northern Taiwan	1,2
		6th	Yilan, Northern Taiwan	1,2
		7th	Taoyuan, Northern Taiwan	1,2
		8th	Hsinchu, Northern Taiwan	1,2

r	2nd Quarter	9th	Miaoli, Central Taiwan	1,2
		10th	Taichung, Central Taiwan	1,2
		11th	Changhua, Central Taiwan	1,2
		12th	Nantou, Central Taiwan	1,2
		13th	Chiayi, Southern Taiwan	1,2
		14th	Taiwan, Southern Taiwan	1,2
		15th	Final Exam	1,2
		16th	Kaohsiung, Southern Taiwan	1,2

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	70	0	0	30	0	0	100
Basic Proficiency	70	0	0	30	0	0	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Japanese

Course Information			
Course Code	103101	Course Category	General / Foreign students
Class Format	Lecture	Credits	School Credit: 4
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	4
Textbook and/or Teaching Materials	高専留学生の日本語　奈良工業高等専門学校国語科　監修／合格日本語能力試験N1,N2　（アルク）、新完全マスター漢字日本語能力試験N1N2　（スリーエーネットワーク）、新完全マスター読解日本語能力試験N2　（スリーエーネットワーク）、日本を話そう　15 のテーマで学ぶ日本事情　（The JAPAN Times）		
Instructor			

Course Objectives

1. Students will acquire basic reading comprehension skills and be able to form their impressions and thoughts and present them orally and in writing.
2. Students will be able to understand classes at technical colleges and will not have trouble communicating with friends.
3. Students will learn about and be interested in Japan's traditional views of nature and culture and develop an interest in issues common to all countries, such as the environment.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Acquire basic reading comprehension skills and be able to express thoughts and ideas in writing	Acquire basic reading comprehension skills and be able to present thoughts and ideas verbally	Have basic reading comprehension
Achievement 2	Able to understand classes at the technical college and have no trouble communicating with friends	Able to understand classes at technical college	Able to communicate with friends
Achievement 3	Know and take an interest in a part of Japan's traditional view of nature and culture and issues common to all countries, such as the environment.	Know and take an interest in Japan's traditional views of nature and culture	Take little interest in traditional Japanese views of nature and culture

Assigned Department Objectives

Teaching Method

Outline	Students will read texts in various genres, acquire basic reading comprehension skills, develop their thoughts and impressions, express them in writing, and develop the ability to present them. Occasionally, Japanese traditional views of nature and culture will be introduced to deepen their interest and curiosity, and specific issues will be introduced to deepen their interest in contemporary Japanese society. Additionally, the class will touch on global issues such as environmental problems to capture the students' interest.
Style	Students must make an effort to learn Japanese grammar, vocabulary, and kanji, not only in their daily lives but also during summer and winter vacations. In addition to deepening their interest in and understanding of Japanese life, culture, and society, I would like to broaden their knowledge and deepen their thoughts on the environment, technological development, and human happiness to help their home countries in the future.
Notice	I would like you to be fully aware that learning Japanese is important, as it is the basis of all learning and school life, and actively strive to understand and learn Japanese.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Japanese	1,2
		2nd	Japanese: You	1,2
		3rd	Japanese: Distinction between the particles "ga" and "wa"	1,2
		4th	Japanese: Cool	1,2
		5th	Japanese: Principle of ko-so-a-do	1,2
		6th	Japanese: Using Keigo	1,2
		7th	Japanese: Keigo	1,2
		8th	Midterm examination	
	2nd Quarter	9th	Japanese: Feelings that words convey	1,2
		10th	Description: Kurobe Dam	1,2
		11th	Description: Antarctic ice	1,2
		12th	Description: Conversations and phone calls	1,2
		13th	Communication	1,2
		14th	Communication	1,2
		15th	Communication	1,2
		16th	Final examination	
2nd Semester	3rd Quarter	1st	Thoughts and opinions: Thinking	1,2
		2nd	Thoughts and opinions: Cherishing things	1,2
		3rd	Thoughts and opinions: Preserving nature	1,2
		4th	Thoughts and opinions: Dialogue	1,2
		5th	Science and technology: Biotechnology	1,2
		6th	Science and technology: Touch	1,2
		7th	Science and technology: Freon gas	1,2
		8th	Midterm examination	
	4th Quarter	9th	Japan and Japanese people: Hands	3
		10th	Japan and Japanese people: Distinction between words	3
		11th	Japan and Japanese people: 3711	3
		12th	Japan and Japanese people: Otsukaresama and Ohayou (Good job and good morning)	3
		13th	Japan and Japanese people: Worship of Western culture	3
		14th	Japan and Japanese people: Scattered flowers are beautiful	3
		15th	Japan and Japanese people: Scattered flowers are beautiful	3
		16th	Final examination	

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	80	0	0	0	0	20	100
Basic Proficiency	80	0	0	0	0	20	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Applied Ethics

Course Information			
Course Code	104211	Course Category	General / Elective
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Being able to consider multicultural coexistence in a global society and express one's opinions.
2. Understanding contemporary forms of warfare and seeking world peace.
3. Understanding the characteristics of various bioethics issues and being able to theoretically develop one's views.
4. Understanding the characteristics of various environmental ethics issues and being able to theoretically develop one's views.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can understand the concepts necessary for multicultural coexistence and can objectively view modern Western values such as freedom and equality and consider effective solutions to practical problems with different cultures.	Can understand that values such as freedom and equality, which we usually take for granted, are never neutral and in some situations may create other kinds of obstacles and inequality and is aware of and can describe issues regarding multicultural coexistence.	Uncritically accepts modern Western values such as freedom and equality and views ideas contrary to them as simply wrong or inferior.
Achievement 2	Can understand the differences between the principles of conduct of other countries and the United Nations, and Japan, and their respective problems, and can consider practical issues such as modern conflicts and civil wars.	Can understand that other countries have different philosophies and principles of conduct in comparison to Japan regarding war, such as international law of war and just war theory and can analyze cases.	When discussing war, can simply express their feelings for peace without understanding the background structure and issues involved.
Achievement 3	Can grasp issues to be considered in bioethical cases from the viewpoints of the parties concerned, their families, medical professionals, etc., and can express one's own views on the issues after understanding the overall picture of the problems.	Can understand the meaning of various concepts surrounding human dignity, such as the right to self-determination and quality of life, and can describe the opposite structures of issues in bioethical cases.	Can consider the issues surrounding life not as an ethical issue but simply on the basis of their own subjective likes and dislikes.
Achievement 4	Can grasp both anthropocentric and ecocentric perspectives in a holistic manner and can apply them to practical environmental issues and express their own viewpoints.	Can understand the advantages and disadvantages of anthropocentrism and ecocentrism and describe the characteristics of each philosophy.	Views environmental issues as merely technical issues or problems that depend on individual volunteerism and lacks the perspective to see them as political and social issues.

Assigned Department Objectives	
Culture (D)	
Teaching Method	
Outline	Based on the first year "Ethics" course, students will consider various issues in modern society based on the ideas of the forerunners and contemporary thinkers in philosophy and ethics. In this course, we will take up a wide range of representative fields of applied ethics, excluding "engineer ethics" such as "bioethics," "war ethics," "multicultural society theory," and "environmental ethics."
Style	The course will be conducted in a lecture format, but group discussions and presentations will also be actively incorporated.
Notice	The practical problems that modern society faces and must overcome will be examined in this course, divided into four main areas. Students will be encouraged to think about topics that are in the news every day, making use of what they have learned in class, and to be able to express their own opinions clearly. * Please note supplementary examinations will not be conducted for this course.

Characteristics of Class / Division in Learning

☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Introduction: Equality and Diversity	1
		2nd	Rawls's Theory of Justice	1
		3rd	Taboo and Boundary: Are We Correct?	1
		4th	Charles Taylor's Communitarianism in the Context of the Quebec Question	1
		5th	Michael Walzer's Theory of Equality: Simple and Complex Equality	1
		6th	Introduction to War Ethics	2
		7th	Kant and Hegel's Theory of War	2
		8th	Michael Walzer's Theory of War	2
	2nd Quarter	9th	Introduction to Bioethics: Advances in Medical Technology and Ethical Issues	3
		10th	The Right to Life and the Right to Death: Euthanasia and Death with Dignity	3
		11th	Eugenics and Enhancement	3
		12th	The Beginning and End of Humans: Abortion, Brain Death, and Organ Transplantation	3
		13th	Introduction to Environmental Ethics: Why Should We Protect the Environment?	4
		14th	Anthropocentrism and Ecocentrism	4
		15th	The Path to Reconciliation with Nature	4
		16th	Final Exam	1-4

Evaluation Method and Weight (%)

	Report	Assignment	Total
Subtotal	60	40	100
Basic Proficiency	60	40	100
Specialized Proficiency	0	0	0
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Law

Course Information			
Course Code	104221	Course Category	General / 選択必修
Class Format	Lecture	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials			
Instructor			

Course Objectives

In today's world of diverse values, the Constitution of Japan serves as a guiding principle for realizing a free and fair society. The Constitution is often thought of as a mere text of ideas and ideals, but it is actually very much related to our real lives. The purpose of this lecture is to provide students with the basic concepts of human rights and government structure conveyed in the Constitution and enable them to examine various issues related to the Japanese Constitution in practice.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can accurately understand the basic principles of the Constitution based on its history.	Can accurately understand the basic principles of the Constitution.	Cannot understand the basic principles of the Constitution.
Achievement 2	Can accurately understand the basic concept of the structure of government and knows exactly how it operates in practice.	Can accurately understand the concept of the structure of government.	Does not accurately understand the concept of the structure of government.
Achievement 3	Has an accurate understanding of the concept of human rights, their types, and their specific applications in judicial precedents.	Has an accurate understanding of the concept of human rights.	Does not understand the concept of human rights.

Assigned Department Objectives	
Culture (D)	
Teaching Method	
Outline	
Style	

Notice	

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☑ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Basic Concepts of the Constitution	1,2
		2nd	Basic Concepts of the Constitution and the State	1,2,3
		3rd	Structure of Constitutionalism	1,2
		4th	Modern Constitutionalism	1,2,3
		5th	History of the Constitution	1,2,3
		6th	General Theory of the Government Structure	1,2
		7th	Power of Constitutional Enactment and Sovereignty	1,2
		8th	The Diet	1,2,3
	2nd Quarter	9th	The Cabinet	1,2
		10th	Judiciary	1,2
		11th	Basic Concepts of Human Rights	1,2,3
		12th	The Right to Liberty	1,2,3
		13th	Social Rights and State Claims	1,2
		14th	Specific Application of Human Rights	1,2,3
		15th	Report Assignments	1,2,3
		16th	Discussion on Report Assignments	1,2,3

Evaluation Method and Weight (%)

	Report	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	100	0	0	0	0	0	100
Basic Proficiency	100	0	0	0	0	0	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Special Lecture on History

Course Information			
Course Code	104231	Course Category	General / Elective
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	Handouts, etc. 参考図書：佐伯徳哉『出雲の中世ー地域と国家のはざまー』吉川弘文館　2017年。		
Instructor			

Course Objectives

1. Comprehensively combining and analyzing ancient documents, paintings, archaeological materials, and scientific data to reconstruct and discuss history.
2. Learning to question, reconsider, and discuss the common knowledge of Japanese history acquired so far.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can reconstruct and explain history in writing by correlating ancient documents, paintings, archaeological materials, scientific data, etc.	Can explain the significance of ancient documents, paintings, archaeological materials, and scientific data in historical reconstruction.	Cannot understand or explain the significance of ancient documents, paintings, archaeological materials, and scientific data.
Achievement 2	Can understand arguments about the history of ancient and medieval systems in Japan, identify the issues, and explain them in writing.	Can understand arguments about the history of ancient and medieval systems in Japan and explain them in writing.	Cannot understand arguments about the history of ancient and medieval systems in Japan.

Assigned Department Objectives

Culture (D)

Teaching Method

Outline	Students will consider the changes in the state system from ancient to medieval times through a study of the historical records on the construction and installation of the deity at the Izumo Taisha Shrine, one of the major shrines in Japan. Through this, they will reconsider the main issues of the history of the systems in ancient and medieval Japan.
Style	This course will be conducted in a lecture format, but it will be conducted in an interactive manner wherein students will be asked to reflect while analyzing historical materials. Students will also be asked to draw a hypothetical reconstruction of an architectural structure based on the contents of the course.
Notice	Students with an interest in history are encouraged to take this class. Please review the topics on ancient and medieval history studied in History 2.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	Guidance: Objectives and contents of the class	
		2nd	Research on the construction of the Izumo Taisha Shrine site and information on the excavation survey	
		3rd	Drawing a hypothetical reconstruction of a large shrine from the Kamakura period (Task)	
		4th	Drawing a hypothetical reconstruction of a large shrine from the Kamakura period (Discussion)	
		5th	Izumo Taisha Shrine as seen in ancient documents	
		6th	Sekkanseiji Era System and the Izumo Taisha Shrine misrepresentation case	
		7th	Mid-term examination	
		8th	Insei Era System and the construction and installation of the Izumo Taisha Shrine (1)	
	2nd Quarter	9th	Insei Era System and the construction and installation of the Izumo Taisha Shrine (2)	
		10th	Construction of the Izumo Taisha Shrine from the establishment of the Kamakura Shogunate from the Heike Administration System	
		11th	Political history of the Kamakura Period and the construction and installation of Izumo Taisha Shrine	
		12th	Construction of the Izumo Taisha Shrine in the late Kamakura Period and the transformation of the Kamakura Shogunate System (1)	
		13th	Construction of the Izumo Taisha Shrine in the late Kamakura period and the transformation of the Kamakura Shogunate System (2)	
		14th	Upheaval in the Northern and Southern Courts and the Izumo Taisha Shrine: Reading Emperor Go-Daigo's edict	
		15th	Final exam	
		16th	Results announcement	

Evaluation Method and Weight (%)							
	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	70	20	0	10	0	0	100
Basic Proficiency	70	20	0	10	0	0	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	International Understanding

Course Information			
Course Code	104251	Course Category	General / Elective
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Understanding, respecting, and coexisting with different cultures.
2. Examining situations in other countries and using the information obtained.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can understand different cultures in depth and can respectfully coexist with them.	Can understand and respectfully coexist with different cultures in general.	Cannot understand different cultures and cannot respectfully coexist with them.
Achievement 2	Can carry out detailed research on situations in other countries and fully use the information obtained.	Can carry out some research on situations in other countries and use the information obtained.	Cannot research situations in other countries and cannot use the information obtained.

Assigned Department Objectives

Culture (D)

Teaching Method

Outline	Understanding the cultures and histories of the countries of the world is essential to build friendly relationships with people of other countries and to achieve mutual understanding between countries in the international community. At the same time, it is important to develop a deep understanding of Japanese culture. This course teaches the cultures and histories of the world and Japan and their relationships in order to train global human resources who can play an active role in the international community.
Style	The course focuses on American culture but does expand its scope to other countries. Japanese guest speakers who have moved abroad and worked for various companies are invited so students may hear about their lived experiences. Students then engage in group discussions with their classmates about situations in other countries. Finally group presentations will be conducted on culture and life in other countries, and students will prepare reports.
Notice	Classes are basically conducted in English. Group discussions and submissions are also expected to be done in English. This course is an academic credit course (2 credits) with a total of 90 hours of study.(Breakdown: 30 hours of class time and 60 hours of self-study.) Self-study equivalent to 60 hours is required to gain credits; this self-study time includes self-study assignments from the instructor, pre-review time for classes, time to consider exercise topics to deepen understanding, and study time to prepare for examinations.

Characteristics of Class / Division in Learning

☑ Active Learning	☑ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	Introduction	1
		2nd	Lecture 1: American Educational Culture	1
		3rd	Guest Speaker 1: The Situation in the United States	1
		4th	Group Discussion 1	2
		5th	Lecture 2: American Lifestyle	1
		6th	Guest speaker 2: The Situation in Australia	1
		7th	Mid-term Examination	
		8th	Group Discussion 2	2
	2nd Quarter	9th	Lecture 3: Social Problems in the United States	1
		10th	Guest speaker 3: The Situation in Vietnam	1
		11th	Group Discussion 3	2
		12th	Lecture 4: Connections of Culture and Language	1
		13th	Guest Speaker 4: The Situation in Singapore	1
		14th	Group Discussion 4	2
		15th	Final Examination Period	
		16th	Presentations on Other Cultures	2

Evaluation Method and Weight (%)			
	Assignment	Presentation	Total
Subtotal	60	40	100
Basic Proficiency	60	40	100
Specialized Proficiency	0	0	0
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Natural Science History

Course Information			
Course Code	104411	Course Category	General / Elective
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials			
Instructor			

Course Objectives

1. Understanding how the Earth's structure has been explored.
2. Being able to explain how the mechanism of earthquake occurrence has been understood.
3. Being able to explain how plate tectonics and the occurrence of megathrust earthquakes have been understood.
4. Being able to explain the characteristics of earthquakes in the Nankai Trough and how they are expected to occur.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Understands how the Earth's structure has been explored.	Understands the Earth's structure.	Does not understand how the Earth's structure has been explored.
Achievement 2	Can substantially explain how the mechanism of earthquake occurrence has been understood.	Understands that earthquakes have been understood as underground fault activity.	Does not understand how earthquakes are understood.
Achievement 3	Can explain how plate tectonics and the occurrence of megathrust earthquakes have been understood.	Understands how plate tectonics have been understood.	Does not understand how plate tectonics have been understood.
Achievement 4	Can explain the characteristics of Nankai Trough earthquakes and how they are expected to occur.	Understands the characteristics of Nankai Trough earthquakes.	Cannot understand the characteristics of Nankai Trough earthquakes and how they are expected to occur.

Assigned Department Objectives

Culture (D)

Teaching Method

Outline	This is a compulsory elective course for the Department of Applied Chemistry and Biotechnology
Style	Lectures based on materials and guard house information
Notice	Geography taught in the first year and Science II in middle school include the fundamentals of geology, so students are encouraged to review the materials. Earthquakes before the Edo period, when instrumental observation records did not exist, have been studied seismologically by reading and interpreting records in ancient documents. There are similar ancient records of most never-before-seen disasters, not just earthquakes. Students are expected to be able to read simple ancient writing and classical Chinese writing.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Guidance, Exploring the Earth's Exterior	1
		2nd	Exploring the Earth's Interior	1
		3rd	Earthquake Records in Ancient Documents, the Earliest Record of a Nankai Trough Megathrust Earthquake Appearing in the Nihon Shoki	4
		4th	History of Nankai Trough Megathrust Earthquakes 1	4
		5th	History of Nankai Trough Megathrust Earthquakes 2	4
		6th	Current Assumptions for Nankai Trough Megathrust Earthquakes	4
		7th	Mid-term Examination	
		8th	History of Seismology, Development of Fault Earthquake Theory	2
	2nd Quarter	9th	Distribution of Initial Motion and Fault Motion	2
		10th	The Kanto Earthquake Dispute between Imamura and Omori	2
		11th	Expressing the Scale of Earthquakes - History of Magnitude	2
		12th	Tohoku Earthquake	3
		13th	Asperity and Comparative Subductology	3
		14th	New Views on Megathrust Earthquakes	3
		15th	Final Exam	1,2,3,4
		16th	Results Announcement	1,2,3,4

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	80	0	0	0	0	20	100
Basic Proficiency	80	0	0	0	0	20	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Special Lecture on Japanese

Course Information			
Course Code	104111	Course Category	General / 選択必修
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	Handouts		
Instructor			

Course Objectives
1. Accurately understanding literary works and logically expressing learned knowledge. 2. Preparing a commentary on works of literature.

Rubric			
	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can accurately understand literary works and express learned knowledge logically.	Can understand literary works.	Cannot understand literary works.
Achievement 2	Can write a commentary on a literary work.	Can explain a literary work.	Cannot explain a literary work.

Assigned Department Objectives

Teaching Method	
Outline	The course will cover early modern to contemporary Japanese literature. Students will learn the literary history of modern and contemporary works, tracing it back to early modern, medieval, and ancient works of literature. Applied Biochemistry is a compulsory elective subject.
Style	If required, students will be instructed on the content to be studied in advance. The focus is on ancient literature. Students should review what they have learned so far, including classical grammar.
Notice	Students should ensure that they submit their assigned report assignment. Students are expected to actively participate in class. Questions are encouraged. This course is an academic credit course (2 credits) with a total of 90 hours of study. (Breakdown: 30 hours of class time and 60 hours of self-study.) Self-study equivalent to 60 hours is required to gain credits; this self-study time includes self-study assignments from the instructor, pre-review time for classes, time to consider exercise topics to deepen understanding, and study time to prepare for examinations.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
2nd Semester	3rd Quarter	1st	Literature of "Love," "Romantic Love," and "Death" (1)	1
		2nd	Literature of "Love," "Romantic Love," and "Death" (2)	1
		3rd	Literature of "Love", "Romantic Love", and "Death" (3)	1
		4th	Literature of "Soul"- "Parents die, children die, then grandchildren die" - (1)	1
		5th	Literature of "Soul"- "Parents die, children die, then grandchildren die" - (2)	1
		6th	Literature of "Soul"- "Parents die, children die, then grandchildren die" - (3)	1
		7th	Mid-term Examination	1
		8th	Literature of "Divination": Creating Destiny - (1)	1,2
	4th Quarter	9th	Literature of "Divination": Creating Destiny - (2)	1
		10th	Literature of "Divination": Creating Destiny - (3)	1
		11th	Literature of "Snow" - Snowfall in Summer - (1)	1
		12th	Literature of "Snow" - Snowfall in Summer - (2)	1
		13th	Literature of "Snow" - Snowfall in Summer - (3)	1
		14th	Literature of "Snow" - Snowfall in Summer - (4)	1
		15th	Final Exam	1
		16th	Results announcement	1,2

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	90	0	0	0	0	10	100
Basic Proficiency	90	0	0	0	0	10	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Practical English

Course Information			
Course Code	104721	Course Category	General / 選択必修
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	Stretch: Starter［Oxford University Press］		
Instructor			

Course Objectives			
1. Acquiring CEFR (Common European Framework of Reference for Languages) A1 level proficiency in English.			
Rubric+AA11:N16			
	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Has an A2 level proficiency in English.	Has an A1 level proficiency in English.	Does not have an A1 level proficiency in English.

Assigned Department Objectives	
Communication Skill (E)	
Teaching Method	
Outline	This course aims to develop students' ability in English at the A1 level of the CEFR (Common European Framework of Reference for Languages) and to raise it to the A2 level. A2: Can understand sentences and frequently use expressions related to areas of most immediate relevance, such as very basic personal and family information, shopping, local geography, employment. Can communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. Can describe in simple terms aspects of their background, immediate environment, and matters in areas of immediate need. A1: Can understand and use familiar everyday expressions and very basic phrases aimed at the satisfaction of needs of a concrete type. Can introduce themselves and others and can ask and answer questions about personal details such as where someone lives, people they know and things they have. Can interact in a simple way provided the other person talks slowly and clearly and is prepared to help.
Style	The class aims to improve communication skills in English by working on basic texts that assume real-life scenarios of daily use. The goal for this class is for students to actually speak and "use" English. Practice is essential to improve communication skills in English. Let's have fun practicing together.
Notice	This course is an academic credit course (2 credits) with a total of 90 hours of study. (Breakdown: 30 hours of class time and 60 hours of self-study.) Self-study equivalent to 60 hours is required to gain credits; this self-study time includes self-study assignments from the instructor, pre-review time for classes, time to consider exercise topics to deepen understanding, and study time to prepare for examinations.

Characteristics of Class / Division in Learning			
☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
2nd Semester	3rd Quarter	1st	Unit 1 Meeting people	1
		2nd	Unit 2 Counties and nationalities	1
		3rd	Unit 3 Family	1
		4th	Unit 4 Describing people	1
		5th	Unit 5 Food and drinks	1
		6th	Unit 6 Things we do	1
		7th	Mid-term exam	1
		8th	Speaking activities	1
	4th Quarter	9th	Unit 7 At home	1
		10th	Unit 8 Free time activities	1
		11th	Unit 9 Popular sports	1
		12th	Unit 10 Big events	1
		13th	Unit 11 Plans	1
		14th	Unit 12 On vacation	1
		15th	End-term exam	1
		16th	Speaking activities	1

Evaluation Method and Weight (%)			
	Examination	Assignment	Total
Subtotal	50	50	100
Basic Proficiency	50	50	100

Niihama College	Year	2023	Course Title	English for Reading and Writing

Course Information			
Course Code	104731	Course Category	General / 選択必修
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	Stretch: Level 1 [Oxford University Press]		
Instructor			

Course Objectives
1. Acquiring English proficiency at the A2 level of the CEFR (Common European Framework of Languages).

Rubric			
	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Has a B1 level proficiency in English.	Has an A2 level proficiency in English.	Has only an A1 level proficiency in English.

Assigned Department Objectives
Communication Skill (E)

Teaching Method	
Outline	This course aims to develop students' ability in English at the A2 level of the CEFR (Common European Framework of Reference for Languages) and to raise it to the B1 level. B1: Can understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure, etc. Can deal with most situations likely to arise while travelling in an area where the language is spoken. Can produce simple connected text on topics that are familiar or of personal interest. A2: Can understand sentences and frequently used expressions related to areas of most immediate relevance, such as very basic personal and family information, shopping, local geography, employment. Can communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. Can describe in simple terms aspects of their background, immediate environment, and matters in areas of immediate need.
Style	The class aims to improve communication skills in English by working on basic texts that assume real-life scenarios of daily use. This class will be filled with opportunities for everyone to practice their oral communication skills. The most important thing in this class is not to aim for perfect English but to strive for understandable English. I hope we can all have fun getting to know each other through English.
Notice	This course is an academic credit course (2 credits) with a total of 90 hours of study. (Breakdown: 30 hours of class time and 60 hours of self-study.) Self-study equivalent to 60 hours is required to gain credits; this self-study time includes self-study assignments from the instructor, pre-review time for classes, time to consider exercise topics to deepen understanding, and study time to prepare for examinations.

Characteristics of Class / Division in Learning			
☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Unit 1 Jobs	1
		2nd	Unit 2 Daily activities	1
		3rd	Unit 3 At the moment	1
		4th	Unit 4 Feelings	1
		5th	Unit 5 On the weekend	1
		6th	Unit 6 Downtown	1
		7th	Mid-term exam	1
		8th	Speaking activities	1
	4th Quarter	9th	Unit 7 People we admire	1
		10th	Unit 8 At a supermarket	1
		11th	Unit 9 Health problems	1
		12th	Unit 10 Cities	1
		13th	Unit 11 Music	1
		14th	Unit 12 Travel plans	1
		15th	End-term exam	1
		16th	Speaking activities	1

Evaluation Method and Weight (%)

	Examination	Assignment	Total
Subtotal	50	50	100
Basic Proficiency	50	50	100

Niihama College	Year	2023	Course Title	Intermediate German

Course Information			
Course Code	104831	Course Category	General / 選択必修
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	アー・ツェット　楽しく学ぶドイツ語、小野寿美子他著、朝日出版社、同学社 / アポロン独和辞典、根本道也他著、同学社		
Instructor			

Course Objectives

Objectives:
To acquire German as a second foreign language and understand different cultures by learning basic German grammar and reading articles and literary works written in German using a dictionary.
Attainment Objectives:
1. Being able to understand and pronounce German sounds.
2. Acquiring knowledge of basic German grammar.
3. Using a dictionary to gain knowledge from German texts.
4. Being able to communicate simple information in German using written and spoken language.
5. Understanding the culture of German-speaking countries and being able to express opinions about it.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can read German sentences aloud with correct pronunciation.	Can read German sentences aloud but makes some pronunciation errors.	Cannot pronounce words.
Achievement 2	Can understand German grammar well.	Can understand some German grammar and solve practice questions.	Has almost no understanding of German grammar and cannot solve practice questions.
Achievement 3	Can roughly understand German sentences using a dictionary.	Can somewhat coherently read sentences using a dictionary.	Cannot use a dictionary and cannot understand German sentences.
Achievement 4	Can communicate simply in German.	Can understand and respond to simple questions in German.	Cannot understand German.
Achievement 5	Can fully understand the culture of German-speaking countries and express opinions about it in Japanese.	Can understand the culture of German-speaking countries to some extent and communicate information about it in Japanese.	Cannot understand the culture of German-speaking countries.

Assigned Department Objectives

Culture (D)

Teaching Method	
Outline	Students will revise the grammar learned in Elementary German and review each new grammar item. They will read articles and parts of literary works written in German using a dictionary. They will also learn about German culture and customs.
Style	Reviewing grammar using the textbook and practice handouts. Working in groups to read German sentences.
Notice	Students are expected to bring a dictionary to class and actively participate in groups and pair work. Pay particular attention to the submission of assignments; some are to be submitted in groups. This course is an academic credit course (2 credits) with a total of 90 hours of study. (Breakdown: 30 hours of class time and 60 hours of self-study.) Self-study equivalent to 60 hours is required to gain credits; this self-study time includes self-study assignments from the instructor, pre-review time for classes, time to consider exercise topics to deepen understanding, and study time to prepare for examinations.

Characteristics of Class / Division in Learning			
☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Guidance, 7. Two uses of adjectives Lesetext 1	1, 2, 3, 5
		2nd	Adjective declensions, comparison of adjectives and adverbs	1, 2, 3
		3rd	Grammar review, Dialogue practice (Restaurant Dialogue) Lesetext 2	1, 2, 4, 5
		4th	8. Separable verbs	1, 2
		5th	Non-Separable verbs Lesetext 3	1, 2, 3, 5
		6th	Review Test zu infinitives and zu infinitive clauses	1, 2, 3
		7th	Mid-term Examination	1, 2, 3, 5
		8th	Dialogue practice (Weekend plans), Reflexive pronouns and reflexive verbs Lesetext 4	1, 2, 3, 4, 5
	4th Quarter	9th	German Culture (Christmas Customs)	3, 5
		10th	Presentation of German Culture (Christmas Customs) Grammar Review	3, 5
		11th	9. Three basic forms of verbs, verbs without ge in the past participle	1, 2, 3
		12th	Present perfect tense Lesetext 5	1, 2, 3, 5
		13th	10. Past tense, Grammar review (What we did over the weekend)	1, 2, 4, 5
		14th	Grammar review, Dialogue practice	1, 2, 3, 4, 5
		15th	End-term Examination	1, 2, 3, 5
		16th	Results Announcements, Explanation	1, 2, 3, 4, 5

Evaluation Method and Weight (%)							
	Examination	Review Test	Assignments, etc.				Total
Subtotal	70	15	15	0	0	0	100
Basic Proficiency	70	15	15	0	0	0	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Intermediate Chinese

Course Information			
Course Code	104841	Course Category	General / 選択必修
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	もっと話そう　異文化おもしろ体験　中級中国語（朝日出版）		
Instructor			

Course Objectives

1. Developing standard Chinese listening comprehension skills.
2. Developing standard Chinese speaking skills.
3. Developing standard Chinese reading skills.
4. Developing standard Chinese writing skills.
5. Gaining a deep understanding of modern Chinese culture and society.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can accurately understand conversations in standard Chinese	Can understand words used in conversations in standard Chinese	Cannot understand words used in conversations in standard Chinese
Achievement 2	Can speak conversational sentences in standard Chinese with correct pronunciation	Can speak words used in sentences in conversations in standard Chinese	Cannot speak words used in sentences in conversations in standard Chinese
Achievement 3	Can accurately understand sentences in standard Chinese based on grammar	Can understand the meaning of words used in sentences in standard Chinese	Cannot understand the meaning of words used in sentences in standard Chinese
Achievement 4	Can accurately write standard Chinese based on grammar	Can write words used in standard Chinese	Cannot write words used in standard Chinese
Achievement 5	Can accurately understand the structure of modern Chinese culture and society	Has a solid understanding of the surface-level aspects of contemporary Chinese culture and society	Cannot understand Chinese culture and society even at a surface level.

Assigned Department Objectives

Culture (D)

Teaching Method

Outline	This course builds on the foundation of the 4th Year course on Elementary Chinese and expands on it. This course is led by a foreign instructor and will focus on the four skills of reading, writing, listening, and speaking, with particular focus on the latter two, so students can develop the language skills necessary for standard daily conversation. In addition, the course will provide students with a deeper understanding of Chinese geography, culture, history, society, lifestyle, customs, etc., and develop human resources who can adapt to an internationalized society.

Style	The course is taught by a foreign instructor and focuses on the four skills of reading, writing, listening, and speaking, with particular emphasis on listening and speaking. Examinations will consist of oral exams. Students will be expected to conduct and submit research on the culture of a Chinese city as a self-study assignment.
Notice	Self-motivated training is essential for language acquisition, so it is recommended that students use CDs. Listening is the prerequisite for speaking. Students who listen well, speak well, and are motivated will certainly be able to master the Chinese language. Students are welcome to come forward with any questions they might have. This course is an academic credit course (2 credits) with a total of 90 hours of study. (Breakdown: 30 hours of class time and 60 hours of self-study.) Self-study equivalent to 60 hours is required to gain credits, and this self-study time includes self-study assignments from the instructor, pre-review time for classes, time to consider exercise topics to deepen understanding, and study time to prepare for examinations.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Lesson 1 School Entrance Ceremony Day	1,2,3,4,5
		2nd	Lesson 1 School Entrance Ceremony Day	1,2,3,4,5
		3rd	Lesson 2 Invitation to Dinner	1,2,3,4,5
		4th	Lesson 2 Invitation to Dinner	1,2,3,4,5
		5th	Lesson 3 In front of the ramen shop	1,2,3,4,5
		6th	Lesson 3 In front of the ramen shop	1,2,3,4,5
		7th	Lesson 4 What shall we eat?	1,2,3,4,5
		8th	Mid-term Examination	1,2
	4th Quarter	9th	Lesson 4 What shall we eat?	1,2,3,4,5
		10th	Lesson 5 The Challenges of Chinese	1,2,3,4,5
		11th	Lesson 5 The Challenges of Chinese	1,2,3,4,5
		12th	Lesson 6 What to do during the summer break?	1,2,3,4,5
		13th	Lesson 6 What to do during the summer break?	1,2,3,4,5
		14th	Lesson 7 Does this dress look good?	1,2,3,4,5
		15th	Lesson 7 Does this dress look good?	1,2
		16th	Final Exam	

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	80	0	0	0	0	20	100
Basic Proficiency	80	0	0	0	0	20	100
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Nature and Human Beings

Course Information			
Course Code	100420	Course Category	General / Compulsory
Class Format	Lecture	Credits	Academic Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	環境科学入門　学術図書出版社　参考書地球汚染1,2　NHK取材班著　（日本放送協会）日本放送協会地球は救えるか1,2　NHK取材班著　（日本放送協会）環境とエネルギー　安藤淳平著　（東京化学同人）地球温暖化の時代スティーブン・H・シュナイダー著　（ダイヤモンド社）地球と人類は持続するか　高辻正基著　（裳華房）エントロピーの法則　J.リフキン著　（詳伝社）沈黙の春　レイチェル・カーソン著　（新潮社）他多数		
Instructor			

Course Objectives

1. Understanding the causes and structures of development issues such as poverty and inequality.
2. Learning to recognize the need for corporate environmental management, conflict resolution between developing and developed countries, sustainable development, and economic systems.
3. Recognizing the need to review the state of modern society and lifestyles from the perspective of a sustainable social environment and regional revitalization.
4. Recognizing the need to work on environmental protection, energy problems, physical and mental health, etc., in light of the new trends in natural science and basic knowledge about the natural environment and life on earth.
5. Recognizing the need to review the state of modern society and lifestyles from a broad perspective on the mechanisms and dynamics of matter and energy.
6. Examining environmental issues from a broad perspective by exploring the human state as the foundation for sustainability from the point of view of thought, art, history, etc.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Understands the connection between life in Japan and international wars and poverty inequality, can think about actions one can take and explain diverse opinions in concrete terms.	Understands the impact of life in Japan on the world, consider multiple actions one can take, and can explain them in concrete terms.	Can understand the impact of life in Japan on the world, but cannot present multiple ideas for action.
Achievement 2	Understands the need for corporate environmental management, conflict resolution between developing and developed countries, sustainable development, and economic systems, and can explain accurately with specific examples.	Can explain the need for corporate environmental management, conflict resolution between developing and developed countries, sustainable development, and economic systems.	Cannot explain the need for corporate environmental management, conflict resolution between developing and developed countries, sustainable development, and economic systems.

Achievement 3	Understands the need to review the state of modern society and lifestyles from the perspective of sustainable social environment and regional revitalization, and can explain accurately with specific examples.	Can explain the need to review the state of modern society and lifestyles from the perspective of sustainable social environment and regional revitalization.	Cannot explain the need to review the state of modern society and lifestyles from the perspective of sustainable social environment and regional revitalization.
Achievement 4	Understands the need to improve environmental protection, energy problems, physical and mental health, etc. in light of the new trends in natural science and basic knowledge about the natural environment and life on earth, and can explain accurately with specific examples.	Can explain the need to improve environmental protection, energy problems, physical and mental health, etc., in light of the new trends in natural science and basic knowledge about the natural environment and life on earth.	Cannot explain the need to improve environmental protection, energy problems, physical and mental health, etc., in light of the new trends in natural science and basic knowledge about the natural environment and life on earth.
Achievement 5	Understands the need to review the state of modern society and lifestyles from a broad perspective on the mechanisms and dynamics of matter and energy and can explain accurately with specific examples.	Can explain the need to review the state of modern society and lifestyles from a broad perspective on the mechanisms and dynamics of matter and energy.	Cannot explain the need to review the state of modern society and lifestyles from a broad perspective on the mechanisms and dynamics of matter and energy.
Achievement 6	Can understand and explain environmental issues in relation to various academic fields by exploring the human state as the foundation for sustainability from the point of view of thought, art, history, etc.	Can explain environmental issues by exploring the human state as the foundation for sustainability from the point of view of thought, art, history, etc.	Cannot explain environmental issues by exploring the human state as the foundation for sustainability from the point of view of thought, art, history, etc.
Assigned Department Objectives			
Culture (D)			
Teaching Method			
Outline	Students will learn about the global environment, the relationship between humans and ecosystems, the pursuit of convenience and the generation of pollution, energy issues, and environmental policies from a universal perspective with reference to concrete examples. They will also develop the ability to consider how humanity should handle the future.		
Style	As a precautionary note, our modern life is based on the massive consumption of energy. From a thermodynamic point of view, it is clear that if continue down this path, our current lifestyle of massive energy consumption will collapse in the near future. The course aims for students to understand the position humans are in, consider what a sustainable society is, and act proactively. Prerequisites, self-study and related subjects: Basic knowledge of Physics 1 and 2, which deal with thermodynamics and energy; and Chemistry 1 and 2, which deal with inorganic and organic chemistry. Students are expected to read and prepare for each topic and item in textbooks, reference books, and the Internet before class.		

Notice	This course is an academic credit course (2 credits) with a total of 90 hours of study. (Breakdown: 30 hours of class time and 60 hours of self-study.) Self-study equivalent to 60 hours is required to gain credits; this self-study time includes self-study assignments from the instructor, pre-review time for classes, time to consider exercise topics to deepen understanding, and study time to prepare for examinations. Students are allowed to appear for the Final Exam only if they submit at least 3/4 (at least 10 out of the 13) assignments assigned by the course instructor by the due date.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	The Objectives of EDS, the 17 SDGs and their Significance. Victims and Perpetrators of Conflict (Yoshikawa)	1,3,4,5
		2nd	Virtual Water, Food Loss (Yoshikawa)	1,3,4,5
		3rd	Economic Rationalism and What We Can Do (Yoshikawa)	1,2,3,4,5
		4th	Nuclear Power (Wada)	1,2,3,4,5,6
		5th	Air Pollution (Wada)	1,2,3,4,5,6
		6th	Pollution Control Measures at Besshi Copper Mine (Wada)	1,2,3,4,5,6
		7th	Humanity and the Earth's Ecosystem (Shirai)	1,2,3,4,5,6
		8th	Energy Resources and Radioactive Isotopes (Shirai)	1,2,3,4,5,6
	2nd Quarter	9th	Garbage Problems and Radioactive Waste (Shirai)	1,2,3,4,5,6
		10th	The Living Earth: Birth, Structure and Activities of the Earth (Kawamura)	1,2,3,4,5,6
		11th	Birth and Evolution of Life: The Threat of Ozone Depletion (Kawamura)	1,2,3,4,5,6
		12th	Food Contamination (Kawamura)	1,2,3,4,5,6
		13th	Vegetation on Earth, Biomes (Matsubara)	1,2,3,4,5,6
		14th	Microcosms (Matsubara)	1,2,3,4,5,6
		15th	Towards an Uncertain Future (Matsubara)	1,2,3,4,5,6
		16th	Final Exam	1,2,3,4,5,6

Evaluation Method and Weight (%)

	Examination	Total
Subtotal	100	100
Basic Proficiency	20	20
Specialized Proficiency	40	40
Cross Area Proficiency	40	40

Niihama College	Year	2023	Course Title	Special Activity

Course Information			
Course Code	109030	Course Category	General / Compulsory
Class Format	Lecture	Credits	School Credit: 0
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Year-round	Classes per Week	1st Semester:1 2nd Semester:1
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

While conducting special activities for each department, students learn about the mindset necessary in daily life and the third year, what to prepare for the fourth year and beyond, and what is required after entering society.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand the necessary mindset in the third year and strive to improve themselves continuously	Able to understand the necessary mindset in the third year	Unable to understand the necessary mindset in the third year
Achievement 2	Able to understand what students need after four years and strive to improve themselves continuously	Able to understand what students need after four years	Unable to understand what students need after four years
Achievement 3	Able to understand what is required after entering society and strive continuously for self-improvement	Able to understand what is required after entering society	Unable to understand what is required after entering society

Assigned Department Objectives

Sociability (F)

Teaching Method

Outline	Conduct activities for each department
Style	Activities for each department conducted by class instructor, as well as activities for the whole-year level and multiple departments
Notice	Be sure to attend and participate in activities

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st	1st Quarter	1st	First semester opening ceremony (3 credit hours; whole activity)	1
		2nd	Wiring test and data recording	1,2
		3rd	Information security	1,2,3
		4th	Notes on off-campus training	1,2,3
		5th	Learning after off-campus training	1,2,3
		6th	Study plan for the exam 1	1,2,3
		7th	Introducing the Kokuryousai Exhibition	1,2,3
		8th	Introducing on-campus events	1,2,3

Semester	2nd Quarter	9th	Grades	1,2,3
		10th	Managing health	1,2,3
		11th	Voting rights	1,2,3
		12th	Explaining the course division	1,2,3
		13th	Study plan for the exam 2	1,2,3
		14th	Questions and answers about course division	1,2,3
		15th	Summer vacation life	1,2,3
		16th	Summary of summer vacation and going through the second semester	1,2,3
2nd Semester	3rd Quarter	1st	Disaster drills	1,2,3
		2nd	Initiatives toward employment and higher education	1,2,3
		3rd	TOEIC	1,2,3
		4th	How to write "reasons for application" in a resume	1,2,3
		5th	Mock essay on reason for application	1,2,3
		6th	Lecture on career education 1	1,2,3
		7th	Study plan for the exam 3	1,2,3
		8th	Questionnaire for on-campus events	1,2,3
	4th Quarter	9th	Mental and physical health survey	1,2,3
		10th	Lecture on career education 2	1,2,3
		11th	Course division request survey 1	1,2,3
		12th	Course division request survey 2	1,2,3
		13th	Description of electives	1,2,3
		14th	Career aspiration survey and elective subject survey	1,2,3
		15th	Creation of class requests	1,2,3
		16th	Annual summary	1,2,3

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	0	0	0	0	0	0	0
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	English Conversation Practice A1

Course Information			
Course Code	104740	Course Category	General / Elective
Class Format	Seminar	Credits	School Credit: 1
Department	Regular Course	Student Grade	0th
Term		Classes per Week	4
Textbook and/or Teaching Materials	オンライン教材		
Instructor			

Course Objectives

This course aims to provide students individualized and optimized learning opportunities using online English conversation. Learners set their own achievement goals and work with the instructor using online lesson materials to improve their English communication skills.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can actively communicate with the instructor in English.	Can communicate with the instructor in English.	Cannot communicate with the instructor in English.

Assigned Department Objectives

Teaching Method

Outline	One credit will be granted to learners who take online lessons outside of class hours if their number of lessons exceeds 30. In addition to the lesson time, students are required to prepare for and review the content of the lessons.
Style	In addition to conversation materials, various other materials are used, such as on pronunciation, grammar, TOEIC preparation, daily news, and so on, which can be obtained from online English conversations. Students will select materials according to their objectives and communicate with the instructor in English as they learn.
Notice	These credits are not counted as credits for advancement but are treated as an "elective course," which counts toward general courses required for graduation. Assessment is based on a grade of "Excellent" or "Not Acceptable." Students are responsible for their own course expenses.

Characteristics of Class / Division in Learning

☑ Active Learning	☑ Aided by ICT	☑ Applicable to Remote Class	☐ Instructor Professionally Experienced

Evaluation Method and Weight (%)

	Conversation	Total
Subtotal	100	100
Basic Proficiency	0	0
Specialized Proficiency	0	0
Cross Area Proficiency	100	100

Niihama College	Year	2023	Course Title	English Conversation Practice A2

Course Information			
Course Code	104741	Course Category	General / Elective
Class Format	Seminar	Credits	School Credit: 1
Department	Regular Course	Student Grade	0th
Term		Classes per Week	4
Textbook and/or Teaching Materials	オンライン教材		
Instructor			

Course Objectives

This course aims to provide students individualized and optimized learning opportunities using online English conversation. Learners set their own achievement goals and work with the instructor using online lesson materials to improve their English communication skills.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can actively communicate with the instructor in English.	Can communicate with the instructor in English.	Cannot communicate with the instructor in English.

Assigned Department Objectives

Teaching Method

Outline	One credit will be granted to learners who take online lessons outside of class hours if their number of lessons exceeds 30. In addition to the lesson time, students are required to prepare for and review the content of the lessons. This course is intended for students who have already completed English Conversation Practice A1 (1 credit).
Style	In addition to conversation materials, various other materials are used, such as on pronunciation, grammar, TOEIC preparation, daily news, and so on, which can be obtained from online English conversations. Students will select materials according to their objectives and communicate with the instructor in English as they learn.
Notice	These credits are not counted as credits for advancement but are treated as an "elective course," which counts toward general courses required for graduation. Assessment is based on a grade of "Excellent" or "Not Acceptable." Students are responsible for their own course expenses.

Characteristics of Class / Division in Learning

☑ Active Learning	☑ Aided by ICT	☑ Applicable to Remote Class	☐ Instructor Professionally Experienced

Evaluation Method and Weight (%)

	Conversation	Total
Subtotal	100	100
Basic Proficiency	0	0
Specialized Proficiency	0	0
Cross Area Proficiency	100	100

Niihama College	Year	2023	Course Title	English Conversation Practice B

Course Information			
Course Code	104742	Course Category	General / Elective
Class Format	Seminar	Credits	School Credit: 2
Department	Regular Course	Student Grade	0th
Term		Classes per Week	8
Textbook and/or Teaching Materials	オンライン教材		
Instructor			

Course Objectives

This course aims to provide students individualized and optimized learning opportunities using online English conversation. Learners set their own achievement goals and work with the instructor using online lesson materials to improve their English communication skills.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can actively communicate with the instructor in English.	Can communicate with the instructor in English.	Cannot communicate with the instructor in English.

Assigned Department Objectives

Teaching Method

Outline	Two credits will be granted to learners who take online lessons outside of class hours if their number of lessons exceeds 60. In addition to the lesson time, students are required to prepare for and review the content of the lessons. Students who have already completed English Conversation Practice A1 or English Conversation Practice A2 are not eligible for this course.
Style	In addition to conversation materials, various other materials are used, such as on pronunciation, grammar, TOEIC preparation, daily news, and so on, which can be obtained from online English conversations. Students will select materials according to their objectives and communicate with the instructor in English as they learn.
Notice	These credits are not counted as credits for advancement but are treated as an "elective course," which counts toward general courses required for graduation. Assessment is based on a grade of "Excellent" or "Not Acceptable." Students are responsible for their own course expenses.

Characteristics of Class / Division in Learning

☑ Active Learning	☑ Aided by ICT	☑ Applicable to Remote Class	☐ Instructor Professionally Experienced

Evaluation Method and Weight (%)

	Conversation	Total
Subtotal	100	100
Basic Proficiency	0	0
Specialized Proficiency	0	0
Cross Area Proficiency	100	100

Niihama College	Year	2023	Course Title	Overseas Language Training A1

Course Information			
Course Code	104750	Course Category	General / Elective
Class Format	Practical training	Credits	School Credit: 1
Department	Regular Course	Student Grade	0th
Term		Classes per Week	4
Textbook and/or Teaching Materials			
Instructor			

Course Objectives

The objective of this course is to provide students a global perspective and improve their language skills and international communication skills by interacting with locals and experiencing a living language environment and different cultures at overseas partner schools.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can actively communicate with locals.	Can communicate with locals.	Cannot communicate with locals.
Achievement 2	Has sufficient international awareness and intercultural competence.	Has a degree of international awareness and intercultural competence.	Does not have a degree of international awareness or intercultural competence.
Achievement 3	Can accurately express the objectives and results of practical training.	Can express the objectives and results of practical training.	Cannot express the objectives and results of practical training.

Assigned Department Objectives

Teaching Method

Outline	Students will improve their communication and intercultural competence through activities in overseas language training (including online training) and pre- and post-study. Training other than what is sponsored by the College is also eligible for this course, and one credit shall be awarded depending on the duration and content.
Style	A training program is to be submitted in advance. During the training, students will be actively involved in various local activities. They shall submit a certificate of completion and other documents after returning to Japan. Materials for a post-program report shall be submitted, and a presentation shall be made at the debriefing session as necessary.
Notice	These credits are not counted as credits for advancement but are treated as an "elective course," which counts toward general courses required for graduation. Assessment is based on a grade of "Excellent" or "Not Acceptable."

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Evaluation Method and Weight (%)

	Report	Presentation	Total
Subtotal	50	50	100
Basic Proficiency	0	0	0
Specialized Proficiency	0	0	0
Cross Area Proficiency	50	50	100

Niihama College	Year	2023	Course Title	Overseas Language Training A2

Course Information			
Course Code	104751	Course Category	General / Elective
Class Format	Practical training	Credits	School Credit: 1
Department	Regular Course	Student Grade	0th
Term		Classes per Week	4
Textbook and/or Teaching Materials			
Instructor			

Course Objectives

The objective of this course is to provide students a global perspective and improve their language skills and international communication skills by interacting with locals and experiencing a living language environment and different cultures at overseas partner schools.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can actively communicate with locals.	Can communicate with locals.	Cannot communicate with locals.
Achievement 2	Has sufficient international awareness and intercultural competence.	Has a degree of international awareness and intercultural competence.	Does not have a degree of international awareness or intercultural competence.
Achievement 3	Can accurately express the objectives and results of practical training.	Can express the objectives and results of practical training.	Cannot express the objectives and results of practical training.

Assigned Department Objectives

Teaching Method

Outline	Students will improve their communication and intercultural competence through activities in overseas language training (including online training) and pre- and post-study. Training other than what is sponsored by the College is also eligible for this course, and one credit shall be awarded depending on the duration and content. This course is intended for students who have already completed Overseas Language Training A1 (1 credit).
Style	A training program is to be submitted in advance. During the training, students will be actively involved in various local activities. They shall submit a certificate of completion and other documents after returning to Japan. Materials for a post-program report shall be submitted, and a presentation shall be made at the debriefing session as necessary.
Notice	These credits are not counted as credits for advancement but are treated as an "elective course," which counts toward general courses required for graduation. Assessment is based on a grade of "Excellent" or "Not Acceptable."

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Evaluation Method and Weight (%)

	Report	Presentation	Total
Subtotal	50	50	100
Basic Proficiency	0	0	0
Specialized Proficiency	0	0	0
Cross Area Proficiency	50	50	100

Niihama College	Year	2023	Course Title	Overseas Language Training B

Course Information			
Course Code	104752	Course Category	General / Elective
Class Format	Practical training	Credits	School Credit: 2
Department	Regular Course	Student Grade	0th
Term		Classes per Week	8
Textbook and/or Teaching Materials			
Instructor			

Course Objectives

The objective of this course is to provide students a global perspective and improve their language skills and international communication skills by interacting with locals and experiencing a living language environment and different cultures at overseas partner schools.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can actively communicate with locals.	Can communicate with locals.	Cannot communicate with locals.
Achievement 2	Has sufficient international awareness and intercultural competence.	Has a degree of international awareness and intercultural competence.	Does not have a degree of international awareness or intercultural competence.
Achievement 3	Can accurately express the objectives and results of practical training.	Can express the objectives and results of practical training.	Cannot express the objectives and results of practical training.

Assigned Department Objectives

Teaching Method

Outline	Students will improve their communication and intercultural competence through activities in overseas language training (including online training) and pre- and post-study. Students may take courses other than those sponsored by the College, and one credit shall be awarded depending on the duration and content. Students who have already completed Overseas Language Training A1 or Overseas Language Training A2 are not eligible for this course.
Style	A training program is to be submitted in advance. During the training, students will be actively involved in various local activities. They shall submit a certificate of completion and other documents after returning to Japan. Materials for a post-program report shall be submitted, and a presentation shall be made at the debriefing session as necessary.
Notice	These credits are not counted as credits for advancement but are treated as an "elective course," which counts toward general courses required for graduation. Assessment is based on a grade of "Excellent" or "Not Acceptable."

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Evaluation Method and Weight (%)

	Report	Presentation	Total
Subtotal	50	50	100
Basic Proficiency	0	0	0
Specialized Proficiency	0	0	0
Cross Area Proficiency	50	50	100

Niihama College	Year	2023	Course Title	Introduction to Plant Designing

Course Information			
Course Code	121499	Course Category	Specialized / Elective
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Acquire and utilize basic knowledge of plant design.
2. Learn how to use a 3D scanner and apply the obtained data to 3D-CAD for interference checking.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to acquire and utilize basic knowledge about plant design	Able to acquire basic knowledge about plant design	Unable to acquire basic knowledge about plant design
Achievement 2	Able to learn how to use a 3D scanner and apply the obtained data to 3D-CAD for interference checking.	Able to learn how to use a 3D scanner	Unable to learn how to use a 3D scanner

Assigned Department Objectives

Teaching Method

Outline	This course is a lecture-style class on the knowledge necessary for next-generation plant engineers. Of the 15 weeks of the course, the classes from the 11th to the 14th week are taught by persons with practical experience in preparing plant piping diagrams. In this course, students acquire the basic knowledge necessary to take the next-generation plant engineer training special course.
Style	Faculty members of Niihama College, National Institute of Technology, from each specialized department and responsible for creating plant piping diagrams are in charge of the relevant fields. By learning contents that the students have not learned in their own specialized department in this class subject, their basic knowledge will be enhanced
Notice	Since students will be learning about content outside their own specialty, they will be asked to approach the course with an awareness of self-learning. Presenting the results in the final week's "presentation" is an essential requirement for credit approval. Preliminary study, self-study, related subjects: Specialized subjects of each department → Main class subjects → 4th year second semester "Plant maintenance"

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester r r	1st Quarter	1st	Introduction to plant engineering 1 (Introduction to plants)	1
		2nd	Introduction to plant engineering 2 (Process design)	1
		3rd	Basic chemical engineering 1 (Distillation)	1
		4th	Basic chemical engineering 2 (Reaction engineering)	1
		5th	Fundamentals of electricity 1 (Fundamentals of electric theory)	1
		6th	Fundamentals of electricity 2 (Electrical safety, receiving and transforming facilities)	1
		7th	Fundamentals of instrumentation 1 (Measurement and control, instrumentation equipment)	1
		8th	Fundamentals of instrumentation 2 (Sequence control)	1
	2nd Quarter	9th	Fundamentals of drafting 1 (Projection, CAD)	1
		10th	Fundamentals of drafting 2 (3D CAD)	1
		11th	Plant scanning practice 1 (Guidance, how to use 3D scanner)	2
		12th	Plant scanning practice 2 (3D scanning practice)	2
		13th	Plant scanning practice 3 (3D CAD practice)	2
		14th	Plant scanning practice 4 (Interference check)	2
		15th	Summary (Student presentation)	1,2
		16th		

Evaluation Method and Weight (%)

	Presentation	Confirmation test	Total
Subtotal	20	80	100
Basic Proficiency	0	0	0
Specialized Proficiency	20	80	100
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Plant Maintenance

Course Information

Course Code	121498	Course Category	Specialized / Elective
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Understand and explain the role of a maintenance engineer.
2. Acquire basic knowledge of maintenance technology and be able to explain it.
3. Acquire basic knowledge of equipment materials and be able to explain them.
4. Acquire basic knowledge of equipment deterioration and be able to explain it.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to understand and explain the role of a maintenance engineer	Able to understand the role of maintenance engineers	Unable to understand the role of a maintenance engineer
Achievement 2	Able to acquire and explain basic knowledge of maintenance technology	Able to acquire basic knowledge of maintenance technology	Unable to acquire basic knowledge of maintenance technology
Achievement 3	Able to acquire and explain basic knowledge of equipment materials	Able to acquire basic knowledge of equipment materials	Unable to acquire basic knowledge of equipment materials
Achievement 4	Able to acquire basic knowledge of equipment deterioration and explain it	Able to acquire basic knowledge of equipment deterioration	Unable to acquire basic knowledge of equipment deterioration

Assigned Department Objectives

Teaching Method

Outline	This course is a lecture-style class on the knowledge necessary for next-generation plant engineers. Of the 15 weeks of the course, the classes from the 1st to the 14th week will be taught by a person with practical experience of being in charge of plant maintenance technology, equipment materials, and material deterioration at a local company. In this course, students acquire basic knowledge about plant maintenance.
Style	By learning from a person with practical experience from a local company as a lecturer, the students can learn what is required at an actual plant site.
Notice	Students will acquire basic knowledge so that the "plant maintenance training" in the first semester of the 5th year will be more fulfilling. Presenting the results in the final week's "presentation" is an essential requirement for credit approval. Preliminary study, self-study, related subjects: 4th year first semester "Plant design basics" → Main course → 5th year first semester "Plant maintenance practice"

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester r	3rd Quarter	1st	Introduction: The role of maintenance engineers and their human resources	1
		2nd	Maintenance technology: Structure of the plant	2
		3rd	Maintenance technology: Plant maintenance management method	2
		4th	Maintenance technology: Failure modes and damage modes of plant equipment	2
		5th	Maintenance technology: Inspection point for plant equipment 1 (towers and heat exchangers)	2
		6th	Maintenance technology: Inspection point for plant equipment 2 (rotating machine, piping)	2
		7th	Equipment Materials: Introduction, steel materials 1 (stress and strain, phase diagram)	3
		8th	Equipment materials: Steel materials 2 (Cast iron, cast steel, carbon steel, low alloy steel)	3
	4th Quarter	9th	Equipment materials: stainless steel, high alloy steel	3
		10th	Equipment material: Non-ferrous metal material	3
		11th	Equipment materials: Polymer materials, ceramic materials, glass materials, graphite materials	3
		12th	Material deterioration: Fracture mode and damage mode, brittle fracture	4
		13th	Material deterioration: Fatigue fracture, creep fracture	4
		14th	Material degradation: Corrosion, stress corrosion cracking, chemical degradation	4
		15th	Summary (Student preparation)	1,2,3,4
		16th		

Evaluation Method and Weight (%)

	Presentation	Confirmation test	Total
Subtotal	20	80	100
Basic Proficiency	0	0	0
Specialized Proficiency	20	80	100
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Practice in Plant Engineering and Co-op1

Course Information			
Course Code	121497	Course Category	Specialized / Elective
Class Format	Practical training	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Intensive	Classes per Week	
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Acquire and utilize basic knowledge of practical training in a plant.
2. Conduct on-site practical training at a company and report the contents.
3. Summarize and give a brief presentation of the contents of the training.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to acquire and utilize basic knowledge about practical training in a plant	Able to acquire basic knowledge of practical training in a plant	Unable to acquire basic knowledge of practical training in a plant
Achievement 2	Able to conduct on-site training at companies and report on the content	Able to conduct on-site training at companies	Unable to implement on-site training at a company
Achievement 3	Able to present training content in a concise and easy-to-understand manner	Able to present the contents of the training	Unable to present the contents of the training

Assigned Department Objectives

Teaching Method

Outline	In this course, during the summer holidays students experience the practical work of a plant engineer under the guidance of a person with experience working in a local company. The students go to local companies and experience practical work in the field in order to emerge as practical plant engineers.
Style	Students will go to a company and experience on-site training.
Notice	Students will undergo an internship at a local plant-related company and experience practical work in the field. Students will experience an application of the knowledge about the plant that they have learned so far in the actual on-site training, and advance their learning by combining theory and practice.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
1st Semester	1st Quarter	1st	On-site training	1,2
		2nd	On-site training	1,2
		3rd	On-site training	1,2
		4th	On-site training	1,2
		5th	On-site training	1,2
		6th	On-site training	1,2
		7th	On-site training	1,2
		8th	On-site training	1,2
	2nd Quarter	9th	On-site training	1,2
		10th	On-site training	1,2
		11th	On-site training	1,2
		12th	On-site training	1,2
		13th	On-site training	1,2
		14th	On-site training	1,2
		15th	On-site training	1,2
		16th	Recital (presentation)	3
2nd Semester	3rd Quarter	1st		
		2nd		
		3rd		
		4th		
		5th		
		6th		
		7th		
		8th		
	4th Quarter	9th		
		10th		
		11th		
		12th		
		13th		
		14th		
		15th		
		16th		

Evaluation Method and Weight (%)				
	Presentation	Report	On-site training	Total
Subtotal	20	40	40	100
Basic Proficiency	0	0	0	0
Specialized Proficiency	20	40	40	100
Cross Area Proficiency	0	0	0	0

Niihama College	Year	2023	Course Title	Practice in Plant Maintenance

Course Information			
Course Code	121599	Course Category	Specialized / Elective
Class Format	Practical training	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Understanding the fundamentals of material testing and quality control and being able to conduct tests in practice
2. Understanding the fundamentals of equipment testing methods and being able to perform the tests
3. Understanding the need for skill transfer and being able to create videos for that purpose

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Understands the fundamentals of material testing and quality control and can conduct tests in practice	Understands the fundamentals of material testing and quality control	Does not understand the fundamentals of material testing and quality control
Achievement 2	Understands the fundamentals of equipment testing and can practically conduct tests	Understands the fundaments of equipment testing	Does not understand the fundamentals of equipment testing
Achievement 3	Understands the need for skill transfer and can create videos for that purpose	Understands the need for skill transfer	Does not understand the need for skill transfer

Assigned Department Objectives

Teaching Method

Outline	This course provides lectures and practical training on the knowledge necessary for next-generation plant engineers. Of the 15-week course, the lectures and practical training for weeks 5–14 will be given by experienced professionals specialized in equipment testing methods (rotating equipment, simple inspection, non-destructive inspection, etc.) and skill transfer methods in the industry. This course aims to train practical plant technicians through hands-on training in plant maintenance conducted in companies.
Style	Experience practical training related to plant maintenance
Notice	Through practical training, students are expected to deepen their understanding of topics covered in the classroom and become practical plant technicians. Presenting during the final week is a prerequisite for acquiring credits. Prerequisites, self-study, and related subjects: 4th Year Second Semester "Plant Maintenance" → This course → 5th Year Second Semester "Human Resource Development for Plant Management"

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Material Testing and Quality Control: Lecture	1
		2nd	Material Testing and Quality Control: Practical 1 (Tensile Testing)	1
		3rd	Material Testing and Quality Control: Practical 2 (Hardness Testing, Impact Testing)	1
		4th	Material Testing and Quality Control: Practical 3 (Corrosion Testing)	1
		5th	Equipment Testing Methods: Lecture 1 (Monitoring and Diagnosis of Rotating Machinery)	2
		6th	Equipment Testing Methods: Practical 1 (Monitoring and Diagnosis of Rotating Machinery)	2
		7th	Equipment Testing Methods: Lecture 2 (Simple Inspection Equipment)	2
		8th	Equipment Testing Methods: Practical 2 (Simple Inspection Equipment)	2
	2nd Quarter	9th	Equipment Testing Methods: Lecture 3 (Non-destructive Testing)	2
		10th	Equipment Testing Methods: Practical 3 (Non-destructive Testing 1)	2
		11th	Equipment Testing Methods: Practical 4 (Non-destructive Testing 2)	2
		12th	Effective Skill Transfer Methods 1 (Necessity of Skill Transfer)	3
		13th	Effective Skill Transfer Methods 2 (Video Creation Practice 1)	3
		14th	Effective Skill Transfer Methods 3 (Video Creation Practice 2)	3
		15th	Summary (Student Presentations)	1,2,3
		16th		

Evaluation Method and Weight (%)

	Presentation	Review Test	Total
Subtotal	20	80	100
Basic Proficiency	0	0	0
Specialized Proficiency	20	80	100
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Training course for Plant Supervisors

Course Information			
Course Code	121598	Course Category	Specialized / Elective
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Understanding the current state of the engineering industry from a global perspective
2. Understanding the basics of AI and IoT technology and accident cases
3. Understanding loss analysis, its improvement, and countermeasures against failure and breakdown
4. Understanding the communication skills required to achieve organizational revitalization

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can understand the current state of the engineering industry from a global perspective	Can understand the current state of the engineering industry	Cannot understand the current state of the engineering industry
Achievement 2	Can understand the fundamentals of AI/IoT and accident cases	Can understand the fundamentals of AI/IoT or accident cases	Cannot understand the fundamentals of AI/IoT and accident cases
Achievement 3	Can understand loss analysis, its improvement, and countermeasures against failure and breakdown	Can understand loss analysis, its improvement, or countermeasures against failure and breakdown	Does not understand loss analysis, its improvement, and countermeasures against failure and breakdown
Achievement 4	Can understand and practice the communication skills required to achieve organizational revitalization	Can understand the communication skills required to achieve organizational revitalization	Does not understand the communication skills required to achieve organizational revitalization

Assigned Department Objectives

Teaching Method

Outline	This course, on the knowledge necessary for the next generation of plant management personnel, is conducted in a lecture format. Of the 15-week course, lectures in weeks 1 through 14 are conducted by experienced professionals specialized in corporate globalization, overseas expansion, AI and IoT technology, and countermeasures against failure and recurrence prevention in local companies. In addition to teaching basic knowledge and technology of plant maintenance, this course aims to develop plant management personnel who can think from a global perspective by learning about AI and IoT technology, accident case studies, and countermeasures against failures and breakdowns.
Style	Students will learn the actual requirements of plant management from professionals working at a local company who have practical experience.

Notice	Students are expected to broaden their insight so that they can think about plant engineering from a global perspective. Presenting during the final week is a prerequisite for acquiring credits. Prerequisites, self-study, and related subjects: 5th Year First Semester "Plant Maintenance Practice" → 5th Year Summer Break "Practice in Plant Engineering and Co-Op" → This course

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
2nd Semester	3rd Quarter	1st	Globalization of People and Companies 1	1
		2nd	Globalization of People and Companies 2	1
		3rd	Current State of the Engineering Industry and Overseas Expansion 1	1
		4th	Current State of the Engineering Industry and Overseas Expansion 2	1
		5th	Smart Factories and AI/IoT Technology 1	2
		6th	Smart Factories and AI/IoT Technology 2	2
		7th	Accident Case Study 1 (Plant Disaster and Safety, Close-call Incidents)	2
		8th	Accident Case Study 2 (Accident Cases and their Application)	2
	4th Quarter	9th	Loss Analysis and Improvement Methods 1 (What is Loss? Current Situation Analysis Methods)	3
		10th	Loss Analysis and Improvement Methods 2 (Why-Why Analysis, PM Analysis)	3
		11th	Concept of Failure/Breakdown Countermeasures and Recurrence Prevention 1 (Basics of Failure)	3
		12th	Concept of Failure/Breakdown Countermeasures and Recurrence Prevention 2 (Failure Analysis)	3
		13th	Communication for Organizational Revitalization 1	4
		14th	Communication for Organizational Revitalization 2	4
		15th	Summary (Student Presentations)	1,2,3,4
		16th		

Evaluation Method and Weight (%)

	Presentation	Review Test	Total
Subtotal	20	80	100
Basic Proficiency	0	0	0
Specialized Proficiency	20	80	100
Cross Area Proficiency	0	0	0

Niihama College	Year	2023	Course Title	Practice in Plant Engineering and Co-op 2

Course Information			
Course Code	121597	Course Category	Specialized / Elective
Class Format	Practical training	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Intensive	Classes per Week	
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Acquiring and utilizing basic knowledge of plant practice
2. Conducting and reporting on electrical practice
3. Conducting and reporting on instrumentation practice
4. Conducting and reporting on safety practice
5. Conducting and reporting on on-site practice at a company

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can understand and use basic knowledge about plant practice	Can understand basic knowledge about plant practice	Does not have basic knowledge about plant practice
Achievement 2	Can conduct and report on the contents of electrical practice	Can conduct electrical practice	Cannot conduct electrical practice
Achievement 3	Can conduct and report on the contents of instrumentation practice	Can conduct instrumentation practice	Cannot conduct instrumentation practice
Achievement 4	Can conduct and report on the contents of safety practice	Can conduct safety practice	Cannot conduct safety practice
Achievement 5	Can conduct and report on on-site practice at a company	Can conduct on-site practice at a company	Cannot conduct on-site practice at a company

Assigned Department Objectives

Teaching Method

Outline	This course is designed for students to experience the practical work of plant engineers under the guidance of experienced workers from local companies during the summer break. The course aims to train practical plant technicians by having students visit local companies and experience on-site practical work.
Style	Visiting a company to experience hands-on practice on site
Notice	Students should position this as the culmination of this special course and perform on-site practice with a high level of awareness and safety. Prerequisites, self-study, and related subjects: 5th Year First Semester "Plant Maintenance Practice" → This course → 5th Year Second Semester "Human Resource Development for Plant Management"

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Electrical Practice (Induction Motors)	1
		2nd	Electrical Practice (Induction Motors)	1
		3rd	Electrical Practice (Induction Motors)	2
		4th	Electrical Practice (Circuit Breakers and	2
		5th	Electrical Practice (Circuit Breakers and	2
		6th	Electrical Practice (Circuit Breakers and	2
		7th	Instrumentation Practice (Flow Meter)	2
		8th	Instrumentation Practice (Flow Meter)	2
	2nd Quarter	9th	Instrumentation Practice (Flow Meter)	3
		10th	Instrumentation Practice (Control Valves)	3
		11th	Instrumentation Practice (Control Valves)	3
		12th	Instrumentation Practice (Control Valves)	3
		13th	Safety Practice	3
		14th	Safety Practice	3
		15th	Safety Practice	4
		16th	Safety Practice	4
2nd Semester	3rd Quarter	1st	On-site Practice	4
		2nd	On-site Practice	5
		3rd	On-site Practice	5
		4th	On-site Practice	5
		5th	On-site Practice	5
		6th	On-site Practice	5
		7th	On-site Practice	5
		8th	On-site Practice	5
	4th Quarter	9th	On-site Practice	5
		10th	On-site Practice	5
		11th	On-site Practice	5
		12th	On-site Practice	5
		13th	On-site Practice	5
		14th	On-site Practice	5
		15th	On-site Practice	5
		16th	Presentation	1,2,3,4,5

Evaluation Method and Weight (%)

	Presentation	Report	Pre-Practice Evaluation	Total
Subtotal	20	40	40	100
Basic Proficiency	0	0	0	0
Specialized Proficiency	20	40	40	100
Cross Area Proficiency	0	0	0	0

Niihama College	Year	2023	Course Title	Introduction to Assistive Technology

Course Information			
Course Code	121489	Course Category	Specialized / Elective
Class Format	Lecture	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	プリント：高専AT技術者スキル標準テキスト（全国KOSEN支援機器開発ネットワーク)		
Instructor			

Course Objectives

・Regarding welfare equipment, the needs to be solved are those of the purchaser (manager) and the operator (caregiver).
・There are cases where the three positions of the parties (patients), such as physical contact, conflict with each other.
Understand and explain what is actually a "product that people can use" when developing products based on them.
・Know human characteristics (ergonomics) and be able to explain that they can be adapted to future development.
・Understand and be able to explain that the effects on the human body differ depending on the shape of objects and the work environment.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to satisfy the needs of each of the three standpoints, understand the patient's psychological resistance, and think about response	Able to understand that it is necessary to satisfy the needs of each of the three standpoints in the development of usable welfare equipment	Unable to understand that the development of usable welfare equipment must satisfy the needs of three different standpoints
Achievement 2	Able to understand human characteristics (ergonomics) and be able to explain what can be applied to future development.	Able to understand human characteristics (ergonomics)	Unable to understand human characteristics (ergonomics) and adaptability to future development
Achievement 3	Able to explain how the shape of objects and the work environment affect the human body differently	Able to understand that the effects on the human body differ depending on the shape of the object and the work environment	Unable to understand that the effects on the human body differ depending on the shape of the object and the work environment

Assigned Department Objectives

Culture (D)

Teaching Method

Outline	Understand the role of and issues in welfare technology, and learn about the actual use of each specialized knowledge in welfare sites (disabled and older adults). In particular, we will try to acquire knowledge in other fields through active learning by talking with the person concerned, understanding problems such as inconveniences due to their characteristics, and so on.
Style	In class, lectures and group discussions are held parallelly, tests and report assignments are given, and the degree of understanding is confirmed.
Notice	Participate actively in discussions because you can use a broad perspective in discussions.

Characteristics of Class / Division in Learning

☑ Active Learning	□ Aided by ICT	☑ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Issues surrounding welfare technology	1
		2nd	Disability, independence, and support	1,2
		3rd	Assistive technology	2,3
		4th	Technologies related to motor and locomotion functions	1,2,3
		5th	Technology related to movement function	2,3
		6th	Technology related to sensory function	2,3
		7th	Midterm examination	2,3
		8th	Technology related to welfare facilities for older adults	2,3
	2nd Quarter	9th	Technology related to the living environment (food environment)	2,3
		10th	Technology related to the living environment (dwelling environment)	2,3
		11th	Technology related to human interface	1,2
		12th	Technology to realize a barrier-free (three barriers and common items) environment	1,2,3
		13th	Foolproof, fail-safe	1,3
		14th	Work environment skills (physiological and psychological adaptation)	2,3
		15th	Final examination	
		16th		

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	90	0	0	0	0	10	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	90	0	0	0	0	10	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Practice in Assistive Design

Course Information			
Course Code	121488	Course Category	Specialized / Elective
Class Format	Seminar	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Second Semester	Classes per Week	2
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Understand the engineering process and be able to produce problem-solving plans that take being fail-safe and fool-proof into consideration
2. Make presentations that non-engineers can understand and find convincing
3. Come up with three types of ideas from the customer's point of view as an AT device

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to design (manufacturing) with clear evidence that take being fail-safe and foolproof into consideration	Produce problem-solving proposals that take being fail-safe and fool-proof into consideration	Unable to produce problem-solving proposals that take being fail-safe and foolproof into consideration
Achievement 2	Able to give concrete form to one's thoughts and give presentations that non-engineers can understand and find convincing	Able to give presentations from which non-engineers can get ideas for problem solving	Unable to give presentations that non-engineers can understand
Achievement 3	Able to come up with three types of ideas from the customer's point of view as an AT device	Able to give concrete form to ideas that satisfy design specifications in response to issues from clinical sites	Unable to give concrete form to ideas that satisfy design specifications

Assigned Department Objectives

Teaching Method

Outline	Propose multiple solutions to problems in actual medical settings and formulate better solutions as a team. After that, the idea is given a concrete form and evaluated by the medical and welfare field.
Style	After understanding the rehabilitation site at convalescent hospitals, individually propose multiple solutions to the issues from the site. To address these issues, the students will receive advice from experts such as physical therapists and formulate a solution plan for each issue in the team. Thereafter, the idea is given concrete form, and the final evaluation before production is received from the medical welfare site.
Notice	Since it is not a craft but an engineering project, the team should work together to create a design (manufacturing) with clear evidence.

Characteristics of Class / Division in Learning

☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
2nd Semester	3rd Quarter	1st	Lecture explanation, purpose, and current status of the product	
		2nd	Learn about medical sites, identify problems, and confirm design conditions	
		3rd	Reporting (presentation) and evaluating (by field staff) ideas	1, 2
		4th	Team concept setting (extraction from on-site needs)	3
		5th	Concept design (creation of multiple ideas)	3
		6th	Evaluation from clinical sites based on needs (selection of ideas)	2,3
		7th	Structural design (overall, flow chart, components)	1,2
		8th	Structural design (overall, flow chart, components)	1,2
	4th Quarter	9th	Structural design (overall, flow chart, components)	1,2
		10th	Detailed design (circuit, parts diagram, etc.)	1,2
		11th	Detailed design (circuit, parts diagram, etc.)	1,2
		12th	Detailed design (circuit, parts diagram, etc.)	1,2
		13th	Preparation of presentation	2
		14th	Presentation and evaluation	2
		15th	Kaizen of solutions	3
		16th	Final presentation	1,2

Evaluation Method and Weight (%)							
	Examination	Presentation			Portfolio	Feasibility of ideas	Total
Subtotal	0	30	0	0	40	30	100
Basic Proficiency	0	0	0	0	40	0	40
Specialized Proficiency	0	0	0	0	0	30	30
Cross Area Proficiency	0	30	0	0	0	0	30

Niihama College	Year	2023	Course Title	Practice in Clinical Equipments Development

Course Information			
Course Code	121589	Course Category	Specialized / Elective
Class Format	Seminar	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Adding industrial design to existing designs that satisfy functionality
2. Understanding and being able to design failsafe and foolproof designs
3. Being able to produce actual machines and summarize results in a report

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can add industrial design to existing designs	Can understand the meaning of industrial designs	Cannot understand the meaning of industrial designs
Achievement 2	Understands and can design failsafe and foolproof designs	Can design incorporating failsafe and foolproof designs	Cannot design failsafe and foolproof designs
Achievement 3	Can evaluate proofs of concept and summarize results in a report	Can create actual machines that can be used as proofs of concept and summarize results in a report	Cannot create actual machines

Assigned Department Objectives

Teaching Method

Outline	To implement selected solutions in the form of actual machines to problems in clinical settings.
Style	Producing actual machines to demonstrate solutions selected in the "Practice in Assistive Design."
Notice	In this course, the proposed solutions selected in "Practice in Assistive Design" will be created as actual devices, and, in the course "Practice in Inclusive Design," the created devices will be evaluated at the clinical site during the summer vacation break so that students will be able to review the design conditions and understand the course objectives, the purpose of the created product, and problems in the medical field Detailed designs based on conceptual designs based on Practice in Assistive Design On foolproof designs and failsafe designs Detailed design for parts ordering Evaluation from clinical sites based on design specifications Production (circuitry, programming, processing, assembly)

Characteristics of Class / Division in Learning			
☑ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Explanation of the course, the purpose of the product, and identification of problems in the medical field and design conditions	
		2nd	Detailed designs based on conceptual designs based on Practice in Assistive Design	1
		3rd	On foolproof designs and failsafe designs	2
		4th	Detailed design for parts ordering	2
		5th		
		6th	Explanation of the course, the purpose of the product, and identification of problems in the medical field and design conditions Detailed designs based on the conceptual designs in Practice in Assistive Design On foolproof designs and failsafe designs Detailed design for parts ordering Evaluation from clinical sites based on design specifications Production (circuitry, programming, processing, assembly)	
		7th	Evaluation from clinical sites based on design specifications Production (circuitry, programming, processing, assembly)	
		8th	Production	
	2nd Quarter	9th	Production	
		10th	Production	
		11th	Production	
		12th	Production	
		13th	Feedback on Results	3
		14th	Improvements to the Product	3
		15th	Preparation of the Report	
		16th	Completion of the Report	

Evaluation Method and Weight (%)

	Examination	Submission	Mutual Evaluations between students	Report	Portfolio	Other	Total
Subtotal	0	20	0	50	30	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Introduction to Medical Welfare Technology

Course Information			
Course Code	121588	Course Category	Specialized / Elective
Class Format	Practical training	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Second Semester	Classes per Week	
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Understanding and applying the social security system of Japan
2. Understanding symptoms of diseases such as dementia and recognizing what needs to be taken into account to solve social problems associated with them
3. Understanding and applying the concept of biofeedback
4. Understanding and applying specifications and quality assurance in the manufacturing of welfare and medical devices

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can understand and apply social security systems	Can understand the social security system of Japan	Does not understand the social security system of Japan
Achievement 2	Can understand and take into account symptoms of diseases such as dementia	Can understand symptoms of diseases such as dementia	Does not understand symptoms of diseases such as dementia
Achievement 3	Can understand and apply the concept of biofeedback	Can understand the concept of biofeedback	Does not understand the concept of biofeedback
Achievement 4	Can understand and apply specifications and quality assurance in the manufacturing of welfare and medical devices	Can understand specifications and quality assurance in the manufacturing of welfare and medical devices	Does not understand specifications and quality assurance in the manufacturing of welfare and medical devices

Assigned Department Objectives

Teaching Method

Outline	Learn the basics of manufacturing, and recognize what needs to be considered to solve problems from diverse perspectives, such as public health, safety, cultural, societal, and environmental impact
Style	Classroom lectures
Notice	The content of this course includes aspects of welfare theory, anatomy, etc. Students are encouraged to attend this course while keeping an open mind in order to learn about Japanese society and the human body. This course is also related to the "Fundamentals of Assistive Technology" course.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☑ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan				
			Theme	Goals
2nd Semester	3rd Quarter	1st	Guidance	
		2nd	Relationship between the Social Security System and Welfare Equipment	1
		3rd	Types and Symptoms of Dementia	2
		4th	Handling Certified Patients	2
		5th	Stroke and its After-effects	2
		6th	Fractures and Frailty	2
		7th	Statistical Processing and Significant Differences in Experimental Data	3
		8th	Testing Hypotheses	3
	4th Quarter	9th	Evidence and Outcomes	3
		10th	Appropriate Sample Sizes	3
		11th	Ethical Validity of Experiments	3
		12th	Biofeedback	4
		13th	Behavioral Analysis Using Engineering Techniques	4
		14th	Research Plans	4
		15th	Examination	
		16th	Summary	

Evaluation Method and Weight (%)						
	Report	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Total
Subtotal	100	0	0	0	0	100
Basic Proficiency	0	0	0	0	0	0
Specialized Proficiency	100	0	0	0	0	100
Cross Area Proficiency	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Practice in Assistive Technology and Co-op

Course Information

Course Code	121587	Course Category	Specialized / Elective
Class Format	Seminar	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Intensive	Classes per Week	
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Understanding and applying experimental designs based on Ethical Guidelines for Medical Research Involving Human Subjects to evaluate products in actual medical settings
2. Understanding and being able to use the effects of non-verbal communication with clinical sites for developed products
3. Being able to consider improvements based on evaluations (checks)

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can understand and apply experimental designs based on Ethical Guidelines for Medical Research Involving Human Subjects in actual medical settings	Can understand experimental designs based on Ethical Guidelines for Medical Research Involving Human Subjects in actual medical settings	Does not understand experimental designs based on Ethical Guidelines for Medical Research Involving Human Subjects
Achievement 2	Can understand and organize the effects of non-verbal communication with clinical sites for developed products	Can understand the effect (evaluation) from clinical sites for developed products	Does not understand the effect (evaluation) from clinical sites for developed products
Achievement 3	Can consider multiple improvement plans through evaluation and make the most appropriate choice	Can consider improvements based on evaluations from clinical sites	Cannot consider improvements based on evaluations (checks)

Assigned Department Objectives

Teaching Method

Outline	The students will evaluate the products manufactured in clinical device development exercises in a clinical setting. Further, based on these evaluations, they will propose improvements and develop devices to be used in a clinical setting.
Style	The products made in the clinical device development exercise will be evaluated in a clinical setting. Further, improvements will be proposed and implemented based on those evaluations.
Notice	This course is based on the "Assistive Design Exercise" and uses products made in the "Clinical Support Device Development Exercise." In addition to experiments at the clinical site, students will conduct data analysis and other activities on campus, with periodic reports via videoconferencing, which will make this a two-week or longer course.

Characteristics of Class / Division in Learning			
☑ Active Learning	☑ Aided by ICT	☐ Applicable to Remote Class	☑ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Clinical Site Guidance	
		2nd	Preparing evaluation tables based on evaluation criteria (design specifications) for clinical device development products	
		3rd	Developing experimental plans for clinical evaluation in the medical field	
		4th	Evaluation and improvement of clinical evaluation	
		5th	Clinical evaluation at the medical site	
		6th	Clinical evaluation at the medical site	
		7th		
		8th		
	2nd Quarter	9th	Conducting re-evaluation at the medical	
		10th		
		11th		
		12th	Conducting re-evaluation at the medical	
		13th	Considering evaluation results and proposing multiple ideas for improvement	
		14th	Practical Report (Summary)	
		15th	Discussion of Improvement Proposals (Evaluation)	
		16th		
2nd Semester	3rd Quarter	1st		
		2nd		
		3rd		
		4th		
		5th		
		6th		
		7th		
		8th		
	4th Quarter	9th		
		10th		
		11th		
		12th		
		13th		
		14th		
		15th		
		16th		

Evaluation Method and Weight (%)

	Examination	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	0	30	0	0	70	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	0	0	0	0	0	0	0
Cross Area Proficiency	0	30	0	0	70	0	100

Niihama College	Year	2023	Course Title	Basic of "Monozukuri" and AI

Course Information			
Course Code	121969	Course Category	Specialized / Elective
Class Format	Practical training	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Intensive	Classes per Week	
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Able to explain the relationship between artificial intelligence and monozukuri (manufacturing)
2. Able to use artificial intelligence with robots

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the relationship between artificial intelligence and manufacturing and present applications	Able to explain the relationship between artificial intelligence and manufacturing	Unable to explain the relationship between artificial intelligence and manufacturing
Achievement 2	Able to use artificial intelligence for subjects not limited to robots	Able to utilize artificial intelligence for the subject of robots	Unable to utilize artificial intelligence for the subject of robots

Assigned Department Objectives

Teaching Method

Outline	In recent years, artificial intelligence (AI) technology has been attracting attention from various fields due to its expected usefulness. It is expected that demand will increase for human resources with knowledge of both the specialized fields taught at this school and the technology of artificial intelligence. The purpose of "Monozukuri and AI" is for students to learn AI technology practically through classroom lectures on AI technology and practical training using data obtained from robots, enabling students to experience how it is utilized in the field of manufacturing. This course focuses on the basics of AI and aims to give students an overview of AI and its potential uses. To teach the basics of AI, this course comprises classroom lectures (lectures and programming about AI, considering its relationship to monozukuri), as well as practical training using data obtained from robots (Items 1–12). These will be offered as intensive lectures during the summer holidays. Based on this knowledge and the acquired skills, students will work on developmental issues at home, present the results at the results report meeting, and summarize them (Items 13–16).
Style	This subject will be delivered as an intensive lecture in the practice room of our school during the summer holidays. After registration, we will inform you of the timing and method of implementation. Moreover, programming uses the programming environment in the practice room and at home. Students are expected to deepen their understanding of the basics of AI programming independently by themselves, not just during the intensive course. Create materials assuming the regular coursework of 2nd- and 3rd-year students. Please refer to the mathematics textbooks and notes used in the core course and read the handouts. Furthermore, various related keywords will be introduced in the practical training. While referring to textbooks and information on the Internet, please be aware of the relationship with each subject you take at our school. Additionally, the faculty member in charge will update the materials as needed.

Notice	Students are not allowed to take this course simultaneously with "Monozukuri and AI (application)." Additionally, students who have acquired credits for "Monozukuri and AI (application)" cannot take this course.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	(Lecture) What is AI?	1
		2nd	(Lecture) Regression and classification	1
		3rd	(Lecture) Solving regression problems	1
		4th	(Lecture) Solving classification problems	1
		5th	(Lecture) Structure of neural network	1
		6th	(Lecture) Neural network learning	1
		7th	(Practice) Fundamentals of programming	2
		8th	(Practice) Fundamentals of programming (continuation)	2
	2nd Quarter	9th	(Practice) AI programming	2
		10th	(Practice) AI programming (continuation)	2
		11th	(Practice) AI programming (continuation)	2
		12th	(Practice) AI programming (continuation)	2
		13th	Problem solving using AI (finding the problem)	2
		14th	Problem solving using AI (searching for solutions)	2
		15th	Problem solving using AI (identifying solutions)	2
		16th	Problem solving using AI (results report meeting)	1,2
2nd Semester	3rd Quarter	1st		
		2nd		
		3rd		
		4th		
		5th		
		6th		
		7th		
		8th		
	4th Quarter	9th		
		10th		
		11th		
		12th		
		13th		
		14th		
		15th		
		16th		

Evaluation Method and Weight (%)

	Report	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	100	0	0	0	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	100	0	0	0	0	0	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Basic of "Monozukuri" and AI

Course Information			
Course Code	121979	Course Category	Specialized / Elective
Class Format	Practical training	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	3rd
Term	Intensive	Classes per Week	
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Explain the relationship between artificial intelligence and manufacturing
2. Use artificial intelligence technology on robots

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the relationship between artificial intelligence and manufacturing, and present application methods	Able to explain the relationship between artificial intelligence and manufacturing.	Unable to explain the relationship between artificial intelligence and manufacturing.
Achievement 2	Able to utilize artificial intelligence technology not limited to robot subjects.	Able to utilize artificial intelligence technology for robot subjects.	Unable to utilize artificial intelligence technology for robot subjects.

Assigned Department Objectives

Teaching Method

Outline	In recent years, artificial intelligence (AI) technology has been attracting attention from various fields, including industry, due to its expected usefulness. It is expected that there will be an increasing demand for human resources who have knowledge in both the specialized fields learned at this school and the technology of artificial intelligence. The purpose of "Monozukuri (manufacturing) and AI" is to learn AI technology practically through classroom lectures on AI technology and practical training using data obtained from robots to experience its utilization in the field of manufacturing. This course focuses on the basics of AI and aims to give students an overview of AI and its potential uses.
Style	Each theme in this course consists of e-learning practice and experiments using robots. Since report assignments and exercises are set in the training materials, the degree of understanding of the training contents will be evaluated by the reports. In addition, experiments will be carried out by each student, mainly using LEGO Mindstorms, in accordance with the school's safety education. A report summarizing the state and results of this experiment will be submitted. Both are submitted through WebClass and are evaluated. Create materials assuming the regular coursework of 2nd and 3rd-year students. Please refer to the mathematics textbooks and notes used in the core course and read the handouts. In addition, various related keywords will be introduced in the practical training. While referring to textbooks and information on the Internet, please be aware of the relationship with each subject you take at our school. In addition, the faculty member in charge will update the materials as needed.
Notice	For this course, the students' report of the two years after the initial course registration will be graded. Students are not allowed to take this course simultaneously with "Monozukuri and AI (application)." In addition, students who have acquired credits for "Monozukuri and AI (application)" cannot take this course.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Guidance	1,2
		2nd	Theme 1 | Fundamentals of robots	2
		3rd	Theme 1 | Robot programming (1)	2
		4th	Theme 1 | Robot programming (2)	2
		5th	Theme 2 | Data analysis and prediction	1
		6th	Theme 2 | Data collection, analysis and prediction	1,2
		7th	Theme 3 | Steepest descent method	1
		8th	Theme 4 | Regression by neural network (1)	1
	2nd Quarter	9th	Theme 4 | Regression by neural network (2)	1
		10th	Theme 4 | Regression by neural network (3)	1
		11th	Theme 4 | Regression by neural network (4)	1
		12th	Theme 4 | Robot production (1)	2
		13th	Theme 4 | Robot production (2)	2
		14th	Theme 5 | Analysis and prediction using actual data	2
		15th	Theme 5 | Prediction by neural network using real data	2
		16th		
2nd Semester	3rd Quarter	1st	Theme 6 | Data classification/linear classification	1
		2nd	Theme 6 | Data collection and analysis (Color)	2
		3rd	Theme 6 | Data classification	2
		4th	Theme 7 | Classification by neural network (1)	1
		5th	Theme 7 | Classification by neural network (2)	1
		6th	Theme 7 | Classification by neural network (3)	1
		7th	Theme 7 | Classification by neural network (4)	1
		8th	Theme 7 | Object recognition (1)	2
	4th Quarter	9th	Theme 7 | Object recognition (2)	2
		10th	Theme 7 | Object recognition (3)	2
		11th	Theme 7 | Object recognition (4)	2
		12th	Theme 8 | Production of a ball-throwing robot (1)	1,2
		13th	Theme 8 | Production of a ball-throwing robot (2)	1,2
		14th	Theme 8 | Production of a ball-throwing robot (3)	1,2
		15th	Theme 8 | Production of a ball-throwing robot (4)	1,2
		16th		

Evaluation Method and Weight (%)

	Report	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Other	Total
Subtotal	100	0	0	0	0	0	100
Basic Proficiency	0	0	0	0	0	0	0
Specialized Proficiency	100	0	0	0	0	0	100
Cross Area Proficiency	0	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Application of "Monozukuri" and AI

Course Information			
Course Code	121968	Course Category	Specialized / Elective
Class Format	Practical training	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Intensive	Classes per Week	
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Explain the relationship between cutting-edge artificial intelligence technology and monozukuri (manufacturing)
2. Use cutting-edge artificial intelligence technology with complex robots as the theme
3. Explain the artificial intelligence technology learned in the course in an easy-to-understand manner

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the relationship between cutting-edge artificial intelligence technology and manufacturing, and present application methods	Able to explain the relationship between cutting-edge artificial intelligence and manufacturing	Unable to explain the relationship between cutting-edge artificial intelligence and manufacturing
Achievement 2	Able to use cutting-edge artificial intelligence technology for subjects that are not limited to complex robots	Able to use cutting-edge artificial intelligence technology with complex robots as the subject matter	Unable to use cutting-edge artificial intelligence technology with complex robots as the subject matter
Achievement 3	Able to explain the artificial intelligence technology learned in the course to people in an easy-to-understand manner, and present an accurate application method.	Able to explain the artificial intelligence technology learned in the course to people in an easy-to-understand manner	Unable to explain the artificial intelligence technology learned in the course to people in an easy-to-understand manner

Assigned Department Objectives	
Teaching Method	
Outline	In recent years, artificial intelligence (AI) technology has been attracting attention from various fields, including industries, due to expectations about its usefulness. It is expected that there will be an increasing demand for human resources who have knowledge of both the specialized fields learned at this school and the technology of AI. The purpose of "Monozukuri and AI" is for students to learn practical AI technology through classroom lectures and practical training using data obtained from robots to experience how it is utilized in the field of manufacturing. This course will focus on cutting-edge content and applications related to AI, and content related to AI technology that is useful to society. In addition, by creating teaching materials for on-site classes during home study, we will establish the basics. In order to acquire practical knowledge about AI, this course consists of practical training using data obtained from robots (summary 1-12) in addition to classroom lectures (lectures and programming on AI technology that can be used at manufacturing sites). These will be held as intensive lectures during the summer holidays. Based on the acquired knowledge and skills, students will create teaching materials to be used in visiting classes at home. The results will be presented at the results report and summarized (Summary 13-16).
Style	This course will be held in our seminar room during the summer holidays. After registering for the course, we will inform you of the timing and method of implementation. In addition, programming can be used not only in the seminar room but also at home. I want you to deepen your understanding of the basics of AI programming on your own, not just during the intensive lectures. Materials will be created assuming that students in the fourth and fifth year of this department will take the course. Please refer to the mathematics textbooks and notebooks used in the core course and read the handouts. In addition, various related keywords will be introduced during the lecture. We would like you to reaffirm the social relevance and significance of each course you take at our school while referring to textbooks and information on the Internet. In addition, the instructor in charge will try to update the materials as much as possible, but we will always accept feedback on parts that are difficult to understand or content that you would like to see added.
Notice	Students are not allowed to take this course simultaneously with Monozukuri and AI (Fundamentals).

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
		1st	(Lecture) Image Recognition by Convolutional Neural Network	1
		2nd	(Lecture) Image Recognition by Convolutional Neural Network (Continuation)	1

1st Semester	1st Quarter	3rd	(Exercise) Implementing Convolutional Neural Networks	2
		4th	(Exercise) Implementing Convolutional Neural Networks (Continuation)	2
		5th	(Lecture) Advanced Topics on Convolutional Neural Networks	1
		6th	(Lecture) Advanced Topics on Convolutional Neural Networks (Continuation)	1
		7th	(Exercise) Implementation of GAN	2
		8th	(Exercise) Implementation of GAN (Continuation)	2
	2nd Quarter	9th	(Lecture) Visualization and anomaly detection of high-dimensional data	1
		10th	(Lecture) Visualization and anomaly detection of high-dimensional data (continued)	1
		11th	(Exercise) Implementation of VAE	2
		12th	(Exercise) Implementation of VAE (Continuation)	2
		13th	Creating teaching materials for AI visiting lectures (lesson plan)	3
		14th	Creating teaching materials for AI visiting lectures (teaching materials creation)	3
		15th	Creating teaching materials for AI visiting lectures (creation of teaching material creation)	3
		16th	Creating teaching materials for AI visiting lectures (presentation)	1,2,3
2nd Semester	3rd Quarter	1st		
		2nd		
		3rd		
		4th		
		5th		
		6th		
		7th		
		8th		
	4th Quarter	9th		
		10th		
		11th		
		12th		
		13th		
		14th		
		15th		
		16th		

Evaluation Method and Weight (%)

	Report	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Total
Subtotal	100	0	0	0	0	100
Basic Proficiency	0	0	0	0	0	0
Specialized Proficiency	100	0	0	0	0	100
Cross Area Proficiency	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Application of "Monozukuri" and AI

Course Information			
Course Code	121978	Course Category	Specialized / Elective
Class Format	Practical training	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	4th
Term	Intensive	Classes per Week	
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Explain the relationship between cutting-edge artificial intelligence technology and monozukuri (manufacturing)
2. Use cutting-edge artificial intelligence technology with complex robots as the theme
3. Explain the artificial intelligence technology you have learned to others in an easy-to-understand manner

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Able to explain the relationship between cutting-edge artificial intelligence technology and manufacturing, and present application methods	Able to explain the relationship between cutting-edge artificial intelligence and manufacturing	Unable to explain the relationship between cutting-edge artificial intelligence and manufacturing
Achievement 2	Able to use cutting-edge artificial intelligence technology for subjects that are not limited to complex robots	Able to use cutting-edge artificial intelligence technology with complex robots as subjects	Unable to use advanced artificial intelligence technology with complex robots as subjects
Achievement 3	Able to explain the artificial intelligence technology the student has learned to people in an easy-to-understand manner, and be able to present an accurate application method.	Able to explain the artificial intelligence technology the student has learned to people in an easy-to-understand manner.	Unable to explain the artificial intelligence technology the student has learned to people in an easy-to-understand manner

Assigned Department Objectives

Teaching Method	
Outline	In recent years, artificial intelligence (AI) technology has been attracting attention from various fields, including industry, because of its expected usefulness. It is expected that there will be an increasing demand for human resources who have knowledge in both the specialized fields learned at this school and the technology of AI. The purpose of "Monozukuri (manufacturing) and AI" is to learn AI technology practically through classroom lectures using data obtained from robots to experience its utilization in the field of manufacturing. This course will focus on cutting-edge content and applications related to AI and deal with content related to AI technology that is useful to society. In addition, students will deepen their understanding of the content of "Basics of Monozukuri (manufacturing) and AI" from the perspective of creating and explaining teaching materials for on-site classes.
Style	Each theme of this course consists of e-learning lectures and experiments using robots. Since report assignments and exercises are set in lecture materials, the degree of comprehension of the lecture contents is evaluated by the reports. Furthermore, experiments will be conducted by each student in accordance with the school's safety education, mainly using Nao6. A report summarizing the state and results of this experiment will be submitted. All reports will be submitted through WebClass and will be evaluated. Materials will be created assuming that regular 4th- and 5th-year students will take the course. Please refer to the mathematics textbooks and notebooks used in the core course and read the handouts. Furthermore, various related keywords will be introduced during the lecture. We would like you to reaffirm the social relevance and significance of each course you take at our school while referring to textbooks and information on the Internet. Furthermore, the instructor in charge will try to update the materials as much as possible, but we will always accept feedback on parts that are difficult to understand or content that you would like to see added.
Notice	After registering for this course, students can take each of the 8 themes in any order. (However, it is desirable to take Theme 5 last because it utilizes the results of other themes.) In addition, a two-year report after the initial course registration will be subject to grade evaluation. We want students to progress steadily at their own pace. Students are not allowed to take this course simultaneously with "Monozukuri and AI (Fundamentals)."

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
	1st Quarter	1st	Theme 1 Classification (object recognition from camera images) lecture	1
		2nd	Theme 1 Classification (object recognition from camera images) lecture (continued)	1
		3rd	Theme 1 Classification (object recognition from camera images) experiment	2
		4th	Theme 1 Classification (object recognition from camera images) experiment (continued)	2

	Quarter	5th	Theme 2 Regression (creating a humanoid robot simulator) lecture	1
		6th	Theme 2 Regression (creating a humanoid robot simulator) lecture (continued)	1
		7th	Theme 2 Regression (creating a humanoid robot simulator) experiment	2
		8th	Theme 2 Regression (creating a humanoid robot simulator) experiment (continued)	2
1st Semester	2nd Quarter	9th	Theme 3 Anomaly detection (What a robot does and does not have) lecture	1
		10th	Theme 3 Anomaly detection (What a robot does and does not have) lecture (continued)	1
		11th	Theme 3 Anomaly detection (What a robot does and does not have) experiment	2
		12th	Theme 3 Anomaly detection (What a robot does and does not have) experiment (continued)	2
		13th	Theme 4 Sound source separation (distinguishing between robot motion sound and object sound) lecture	1
		14th	Theme 4 Sound source separation (distinguishing between robot motion sound and object sound) lecture (continued)	1
		15th	Theme 4 Sound source separation (distinguishing between robot motion sound and object sound) experiment	2
		16th	Theme 4 Sound source separation (distinguishing between robot motion sound and object sound) experiment (continued)	2
	3rd Quarter	1st	Theme 5 Product inspection (removal of defective products using sensor data) lecture	1
		2nd	Theme 5 Product inspection (removal of defective products using sensor data) lecture (continued)	1
		3rd	Theme 5 Product inspection (removal of defective products using sensor data) experiment	2
		4th	Theme 5 Product inspection (removal of defective products using sensor data) experiment (continued)	2
		5th	Theme 6 Manufacturing methods and services using AI (Discussion) 1	1,3
		6th	Theme 6 Manufacturing methods and services using AI (Discussion) 2	1,3

		7th	Theme 6 Manufacturing methods and services using AI (Discussion) 3	1,3
		8th	Theme 6 Manufacturing methods and services using AI (presentation)	1,3
2nd Semester	4th Quarter	9th	Theme 7 Manufacturing and AI (Fundamentals) Preparing for visiting classes (1)	1,2,3
		10th	Theme 7 Manufacturing and AI (Fundamentals) Preparing for visiting classes (2)	1,2,3
		11th	Theme 7 Manufacturing and AI (Fundamentals) Preparing for visiting classes (3)	1,2,3
		12th	Theme 7 Manufacturing and AI (Fundamentals) Preparing for visiting classes (4)	1,2,3
		13th	Theme 8 Manufacturing and AI (Fundamentals) presentation assuming visiting class (1)	1,2,3
		14th	Theme 8 Manufacturing and AI (Fundamentals) presentation assuming visiting class (2)	1,2,3
		15th	Theme 8 Manufacturing and AI (Fundamentals) presentation assuming visiting class (3)	1,2,3
		16th	Theme 8 Manufacturing and AI (Fundamentals) presentation assuming visiting class (4)	1,2,3

Evaluation Method and Weight (%)

	Report	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Total
Subtotal	100	0	0	0	0	100
Basic Proficiency	0	0	0	0	0	0
Specialized Proficiency	100	0	0	0	0	100
Cross Area Proficiency	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Application of "Monozukuri" and AI

Course Information

Course Code	121968	Course Category	Specialized / Elective
Class Format	Practical training	Credits	School Credit: 1
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Intensive	Classes per Week	
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Can explain the relationship between state-of-the-art artificial intelligence technology and manufacturing
2. Can use state-of-the-art artificial intelligence technology using complex robots as a subject
3. Can explain AI technologies learned to people in an easy-to-understand manner

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can explain the relationship between state-of-the-art artificial intelligence technology and manufacturing and present application methods	Can explain the relationship between state-of-the-art artificial intelligence and manufacturing	Cannot explain the relationship between state-of-the-art artificial intelligence and manufacturing
Achievement 2	Can use state-of-the-art artificial intelligence technology for subjects not limited to complex robots	Can use state-of-the-art artificial intelligence technology using complex robots as subjects	Cannot use state-of-the-art artificial intelligence technology for complex robots
Achievement 3	Can explain AI technologies learned to others in an easy-to-understand manner and present correct methods of application	Can explain AI technologies learned to people in an easy-to-understand manner	Cannot explain AI technologies learned to people in an easy-to-understand manner

Assigned Department Objectives

Teaching Method

Outline	Artificial intelligence (AI) technology has been attracting attention in recent years from various fields due to the anticipation of its utility. It is expected that the need for human resources with knowledge in specialized fields and AI technology, which students learn at the school, will increase. The objective of "Monozukuri and AI" is to have students learn AI technology practically in classroom lectures and hands-on training using data obtained from robots to experience how AI can be used in the field of manufacturing. In particular, this course focuses on state-of-the-art content and applied elements of AI, and students learn about AI technologies useful to society. Additionally, students will learn the fundamentals of AI technology by creating teaching materials for visiting lectures. For students to acquire practical knowledge about AI, this course comprises class lectures (AI technologies that can be used in manufacturing and programming) and practical training using data obtained from robots programming on AI technology (Items 1–12). These will be offered as intensive lectures during summer breaks and other periods. Based on this knowledge and skills, students will develop teaching materials at home that will be used in visiting lectures. The results will be presented at a presentation meeting and will be summarized (Items 13–16).

Style	This course will be offered as an intensive course in the school's seminar room during the summer break. The timing and method of the course will be communicated shortly after registration. Further, students are expected to use the programming environment available at home as well as the seminar room. Students are encouraged to deepen their understanding of the fundamentals of AI programming during their intensive course lectures, as well as through hands-on experience. Materials will be prepared assuming that the students will be from the 4th and 5th years of the regular course. Students will be expected to read the handouts with reference to the mathematics textbooks and notebooks used in the main course. Various related keywords will also be introduced during the lectures. While referring to textbooks and information on the Internet, students should reconsider the relevance and significance to society of each subject they take at the school. The instructor will endeavor to update the materials to the best of their ability but will accept feedback on areas difficult to understand or for additional content as required.
Notice	Concurrent enrollment in "Monozukuri and AI (Fundamentals)" is not permitted.

Characteristics of Class / Division in Learning			
☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	(Lecture) Image Recognition by Convolutional Neural Networks	1
		2nd	(Lecture) Image Recognition by Convolutional Neural Networks (Continued)	1
		3rd	(Practical) Implementation of Convolution Neural Networks	2
		4th	(Practical) Implementation of Convolutional Neural Networks (Continued)	2
		5th	(Lecture) Developmental Topics on Convolutional Neural Networks	1
		6th	(Lecture) Developmental Topics on Convolutional Neural Networks (Continued)	1
		7th	(Practical) Implementation of GAN	2
		8th	(Practical) Implementation of GAN (Continued)	2
	2nd Quarter	9th	(Lecture) Visualization of High-Dimensional Data and Abnormality Detection	1
		10th	(Lecture) Visualization of High-Dimensional Data and Abnormality Detection (Continued)	1
		11th	(Practical) Implementation of VAE	2
		12th	(Practical) Implementation of VAE (Continued)	2
		13th	Creation of teaching materials for visiting lectures on AI (Lesson Design)	3
		14th	Creation of teaching materials for visiting lectures on AI (Lesson Creation)	3
		15th	Creation of teaching materials for visiting lectures on AI (Lesson Creation Continued)	3
		16th	Creation of teaching materials for visiting lectures on AI (Result Presentation Meeting)	1,2,3
2nd Semeste	3rd Quarter	1st		
		2nd		
		3rd		
		4th		
		5th		
		6th		
		7th		
		8th		

Semester	4th Quarter	9th		
		10th		
		11th		
		12th		
		13th		
		14th		
		15th		
		16th		

Evaluation Method and Weight (%)

	Report	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Total
Subtotal	100	0	0	0	0	100
Basic Proficiency	0	0	0	0	0	0
Specialized Proficiency	100	0	0	0	0	100
Cross Area Proficiency	0	0	0	0	0	0

Niihama College	Year	2023	Course Title	Application of "Monozukuri" and AI

Course Information			
Course Code	121978	Course Category	Specialized / Elective
Class Format	Practical training	Credits	School Credit: 2
Department	Department of Applied Chemistry and Biotechnology	Student Grade	5th
Term	Intensive	Classes per Week	
Textbook and/or Teaching Materials	Handouts, etc.		
Instructor			

Course Objectives

1. Can explain the relationship between state-of-the-art artificial intelligence technology and manufacturing
2. Can use state-of-the-art artificial intelligence technology using complex robots as a subject
3. Can explain AI technologies learned to people in an easy-to-understand manner

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can explain the relationship between state-of-the-art artificial intelligence technology and manufacturing and present application methods	Can explain the relationship between state-of-the-art artificial intelligence and manufacturing	Cannot explain the relationship between state-of-the-art artificial intelligence and manufacturing
Achievement 2	Can use state-of-the-art artificial intelligence technology for subjects not limited to complex robots	Can use state-of-the-art artificial intelligence technology using complex robots as subjects	Cannot use state-of-the-art artificial intelligence technology for complex robots
Achievement 3	Can explain AI technologies learned to others in an easy-to-understand manner and present correct methods of application	Can explain AI technologies learned to people in an easy-to-understand manner	Cannot explain AI technologies learned to people in an easy-to-understand manner

Assigned Department Objectives

Teaching Method

Outline	Artificial intelligence (AI) technology has been attracting attention in recent years from various fields due to the anticipation of its utility. It is expected that the need for human resources with knowledge in specialized fields and AI technology, which students learn at the school, will increase. The objective of "Monozukuri and AI" is to have students learn AI technology practically in classroom lectures and experiments using robots to experience how AI can be used in the field of manufacturing. In particular, this course focuses on state-of-the-art content and applied elements of AI, and students learn about AI technologies useful to society. Additionally, students will deepen their understanding of the contents of "Monozukuri and AI (Fundamentals)" from the perspective of creating and explaining teaching materials for conducting visiting lectures.

Style	Each topic in this course comprises an e-learning lecture and experiment using robots. Report tasks and exercises are set in the lecture materials to evaluate the students' understanding. Experiments will be conducted independently by the students in accordance with the school's safety education and will be conducted mainly using Nao6. Students will submit a report summarizing the experiment and its results. Both will be submitted through Web Class and evaluated. Materials will be prepared assuming that the students will be from the 4th and 5th years of the regular course. Students will be expected to read the handouts with reference to the mathematics textbooks and notebooks used in the main course. Various related keywords will also be introduced during the lectures. While referring to textbooks and information on the Internet, students should reconsider the relevance and significance to society of each subject they take at the school. The instructor will endeavor to update the materials to the best of their ability but will accept feedback on areas difficult to understand or for additional content as required.
Notice	After registering for this course, students may study each of the eight topics in any order (although topic 5 should be taken last because it uses the results of the other themes). Report results for two years after the initial registration will be graded. Students are expected to proceed at their own pace. Further, concurrent enrollment in "Monozukuri and AI (Fundamentals)" is not permitted.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☐ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Topic 1 Classification (Object Recognition from Camera Images) Lecture	1
		2nd	Theme 1 Classification (Object Recognition from Camera Images) Lecture (Continued)	1
		3rd	Topic 1 Classification (Object Recognition from Camera Images) Experiment	2
		4th	Topic 1 Classification (Object Recognition from Camera Images) Experiment	2
		5th	Topic 2 Regression (Building a Humanoid Robot Simulator) Lecture	1
		6th	Topic 2 Regression (Building a Humanoid Robot Simulator) Lecture (Continued)	1
		7th	Topic 2 Regression (Building a Humanoid Robot Simulator) Experiment	2
		8th	Topic 2 Regression (Building a Humanoid Robot Simulator) Experiment (Continued)	2
	2nd Quarter	9th	Topic 3 Anomaly Detection (Does the Robot Have Something? Does it not?) Lecture	1
		10th	Topic 3 Anomaly Detection (Does the Robot Have Something? Does it not?) Lecture	1
		11th	Topic 3 Anomaly Detection (Does the Robot Have Something? Does it not?) Experiment	2
		12th	Topic 3 Anomaly Detection (Does the Robot Have Something? Does it not?) Experiment	2
		13th	Topic 4 Sound Source Separation (Distinguishing between Robot Movement	1
		14th	Topic 4 Sound Source Separation (Distinguishing between Robot Movement	1

		15th	Topic 4 Sound Source Separation (Distinguishing between Robot Movement	2
		16th	Topic 4 Sound Source Separation (Distinguishing between Robot Movement	2
2nd Semester	3rd Quarter	1st	Topic 5 Product Inspection (Using Sensor Data to Remove Abnormal Products) Lecture	1
		2nd	Topic 5 Product Inspection (Using Sensor Data to Remove Abnormal Products) Lecture	1
		3rd	Topic 5 Product Inspection (Using Sensor Data to Remove Abnormal Products)	2
		4th	Topic 5 Product Inspection (Using Sensor Data to Remove Abnormal Products)	2
		5th	Topic 6 Methods and Services for Manufacturing Using AI (Discussion) 1	1,3
		6th	Topic 6 Methods and Services for Manufacturing Using AI (Discussion) 2	1,3
		7th	Topic 6 Methods and Services for Manufacturing Using AI (Discussion) 3	1,3
		8th	Topic 6 Methods and Services for Manufacturing Using AI (Presentation)	1,3
	4th Quarter	9th	Topic 7 "Monozukuri and AI (Fundamentals)" Preparation for Visiting Lectures (1)	1,2,3
		10th	Topic 7 "Monozukuri and AI (Fundamentals)" Preparation for Visiting Lectures (2)	1,2,3
		11th	Topic 7 "Monozukuri and AI (Fundamentals)" Preparation for Visiting Lectures (3)	1,2,3
		12th	Topic 7 "Monozukuri and AI (Fundamentals)" Preparation for Visiting Lectures (4)	1,2,3
		13th	Topic 8 "Monozukuri and AI (Fundamentals)" Presentation Assuming Visiting Lectures (1)	1,2,3
		14th	Topic 8 "Monozukuri and AI (Fundamentals)" Presentation Assuming Visiting Lectures (2)	1,2,3
		15th	Topic 8 "Monozukuri and AI (Fundamentals)" Presentation Assuming Visiting Lectures (3)	1,2,3
		16th	Topic 8 "Monozukuri and AI (Fundamentals)" Presentation Assuming Visiting Lectures (4)	1,2,3

Evaluation Method and Weight (%)

	Report	Presentation	Mutual Evaluations between students	Behavior	Portfolio	Total
Subtotal	100	0	0	0	0	100
Basic Proficiency	0	0	0	0	0	0
Specialized Proficiency	100	0	0	0	0	100
Cross Area Proficiency	0	0	0	0	0	0