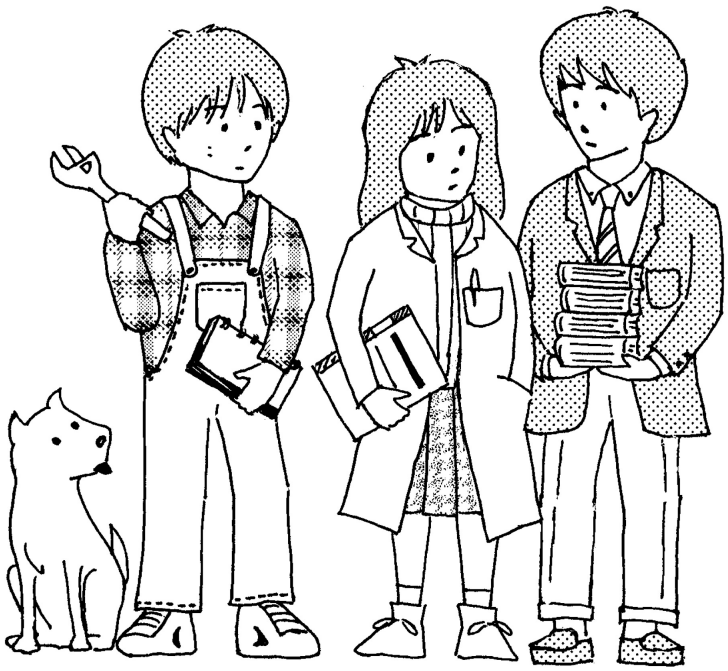
SYLLABUS *2018*

[F] Industrial Chemistry



Kyoto University, Faculty of Engineering

[F] Industrial Chemistry

Industrial Chemistry

74050

Introduction to Industrial Chemistry

工業化学概論

【Code】74050 【Course Year】1st year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	2	
	2	
	2	
	2	
	2	
	2	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

71020

Physical Chemisry: Fundamentals and Exercises

物理化学基礎及び演習

【Code】71020 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】 【Language】Japanese

【Instructor】Tanaka, Miyahara, Koga, Sugase, Umeyama, Tanabe

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	3	
	4	
	2	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71030

Exercises in Basic Organic Chemistry

有機化学基礎及び演習

【Code】71030 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】 【Language】Japanese

【Instructor】T. Kondo, A. Nagaki, T. Kurahashi, I. Hamachi, S. Yamago, E. Kayahara

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	3	
	1	
	2	
	2	
	2	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71040

Basic Inorganic Chemistry

基礎無機化学

【Code】71040 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】K. Tanaka, K. Miura, R. Abe, K. Fujita, S. Takai, T. Matsui

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	4	
	5	
	5	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71050

Fundamentals of Chemical Process Engineering

化学プロセス工学基礎

【Code】71050 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Sano, Miyahara, R. Yamamoto, Mae, Kawase, Nakagawa, Maki, Ashida

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	2	
	2	
	1	
	1	
	0.5	
	1	
	1.5	
	1	
	2	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

74060

Introduction of Polymer Chemistry

高分子化学序論

【Code】74060 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Kazunari Akiyoshi

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	5	
	3	
	4	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

71120

Physical Chemistry I (Frontier Chemistry)

物理化学 I (創成化学)

【Code】71120 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】【Language】Japanese 【Instructor】Tsuyoshi Koga, Koji Nishida

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	3	
	3	
	3	
	3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

71110

Organic Chemistry I (Frontier Chemistry)

有機化学 I（創成化学）

【Code】71110 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Yoshiaki Nakao

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	4	
	3	
	3	
	2	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

Inorganic Chemistry (Frontier Chemistry)

無機化学 (創成化学)

【Code】71130 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Kiyotaka Miura, Yasuhiko Shimotsuma, Masayuki Nishi

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	3	
	4	
	4	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

71140

Analytical Chemistry (Frontier Chemistry)

分析化学（創成化学）

【Code】71140 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】K. Otsuka,M. Oyama,T. Kubo,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Principle of Chemical Equilibrium	2	
Acid-Base Equilibrium	4	
Complex-Formation Equilibrium	4	
Oxidation-Redcution Equilibrium	4	
	1	

【Textbook】Daniel C. Harris: Quantitative Chemical Analysis (W.H. Freeman, 9th Ed., 2016)

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71150

Elements of Polymer Chemistry I (Frontier Chemistry)

高分子化学基礎 I (創成化学)

【Code】71150 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Hideki Matsuoka, Koji Nishida

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	1	
	2	
	1	
	1	
	1	
	2	
	2	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

71320

Mathematics of Chemistry (Frontier Chemistry)

化学数学（創成化学）

【Code】71320 【Course Year】2nd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Toshikazu Takigawa, Yo Nakamura

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	1	
	1	
	1	
	1	
	2	
	1	
	1	
	1	
	1	
	1	
	1	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71350

Frontier Chemistry Laboratory I(Frontier Chemistry)

創成化学実験 I（創成化学）

【Code】71350 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】7 【Restriction】

【Lecture Form(s)】 【Language】Japanese 【Instructor】Teaching staff in department of Frontier Chemistry

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	6	
	6	
	12	
	9	
	3	
	9	
	15	
	6	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

71360

Frontier Chemistry Laboratory II(Frontier Chemistry)

創成化学実験 II（創成化学）

【Code】71360 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】7 【Restriction】

【Lecture Form(s)】 【Language】Japanese 【Instructor】,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	6	
	12	
	9	
	3	
	9	
	15	
	6	
	6	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

71190

Physical Chemistry II (Frontier Chemistry)

物理化学 II (創成化学)

【Code】71190 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Yoshinobu Tsujii, Kohji Ohno

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	2	
	2	
	4	
	3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

71170

Organic Chemistry II (Frontier Chemistry)

有機化学 II（創成化学）

【Code】71170 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Seijiro Matsubara

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	3	
	3	
	3	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71220

Instrumental Analytical Chemistry (Frontier Chemistry)

機器分析化学（創成化学）

【Code】71220 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】K. Otsuka, M. Oyama, T. Kubo,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Chromatography	4	
Spectroscopy	5	
Electrochemical Analysis	5	
	1	

【Textbook】Daniel C. Harris: Quantitative Chemical Analysis (W.H. Freeman, 9th Ed., 2016)

【Textbook(supplemental)】Douglas A. Skoog, F. James Holler, Stanley R. Crouch :Principles of Instrumental Analysis(Cengage Learning, 7th Ed., 2017)

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71200

Elements of Polymer Chemistry II (Frontier Chemistry)

高分子化学基礎 II (創成化学)

【Code】71200 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Makoto Ouchi, Junichi Horinaka

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	2	
	3	
	3	
	4	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71180

Biorelated Material Chemistry (Frontier Chemistry)

生体関連物質化学 (創成化学)

【Code】71180 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Shunsaku Kimura, Yusuke Arima, Masashi Ohmae

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	4	
	4	
	4	
	3	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71210

Introduction to Statistical Thermodynamics (Frontier Chemistry)

統計熱力学入門（創成化学）

【Code】71210 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Takenao Yoshizaki

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	3	
	3	
	3	
	3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

71240

Physical Chemistry III (Frontier Chemistry)

物理化学 III (創成化学)

【Code】71240 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Hideo Ohkita

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	4	
	2	
	2	
	2	
	1	
	1	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

71230

Organic Chemistry III (Frontier Chemistry)

有機化学 III（創成化学）

【Code】71230 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Takuya Kurahashi, Yoshihiro Sasaki

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	2	
	2	
	2	
	2	
	4	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

71330

Coordination Chemistry (Frontier Chemistry)

錯体化学 (創成化学)

【Code】71330 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Katsuhisa Tanaka, Koji Fujita,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	3	
	3	
	2	
	3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71260

Advanced Instrumental Analysis (Frontier Chemistry)

最先端機器分析（創成化学）

【Code】71260 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】K. Otsuka, M. Oyama, T. Kubo,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
High-performance Separation Analysis	4	
Electrochemical Analysis, Advanced	4	
Spectroscopic Analysis 1	1	
Spectroscopic Analysis 2	4	
Topics	1	
	1	

【Textbook】Daniel C. Harris: Quantitative Chemical Analysis (W.H. Freeman, 9th Ed., 2016)

【Textbook(supplemental)】Douglas A. Skoog, F. James Holler, Stanley R. Crouch :Principles of Instrumental Analysis(Cengage Learning, 7th Ed., 2017)

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71300

Polymer Chemistry I

高分子化学 I

【Code】71300 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese
【Instructor】Makoto Ouchi, Kazuo Tanaka
【Course Description】Based on the courses "Fundamental Polymer Science I and II" (covering polycondensation and radical polymerization), this course is to discuss the concepts and the characteristics of coordination, stereospecific, ionic (anionic and cationic), ring-opening, and living polymerizations. Examples are provided for initiators, monomers, reaction mechanism, polymerization intermediates, and produced polymers.
【Grading】Written Examination
【Course Goals】To discuss fundamental aspects of polymer chemistry, particularly the fundamental nature of polymers and their synthesis (polymerization reactions).
【Course Topics】

Theme	Class number of times	Description
Coordination Polymerization	2	To discuss: The fundamentals of coordination and Ziegler-Natta polymerizations, including ring-opening metathesis polymerization, and the relation between catalyst design and polymerization mechanism.
Stereospecific Polymerization	2	To discuss: The fundamentals of stereospecific polymerization, polymer characterization therein, and the relation between polymer steric structure and polymerization mechanism.
Study Achievement Test (1)	1	To examine as "feed-back": The achievement of studying in the subjects that have already been discussed (coordination and stereospecific polymerizations).
Anionic Polymerization	3	To discuss: The fundamental of anionic polymerization, including initiators, monomers, their structure – reactivity relationships, elementary reactions, kinetics. and reaction mechanisms.
Cationic Polymerization	3	To discuss: The fundamental of cationic polymerization, including initiators, monomers, their structure – reactivity relationships, elementary reactions, kinetics. and reaction mechanisms.
Ring-Opening Polymerization	1	To discuss: The fundamental of ring-opening polymerization, including initiators, monomers, their structure – reactivity relationships, elementary reactions, kinetics. and reaction mechanisms.
Living Polymerization	2	To discuss: The definition and examples of "living" polymerization, including initiators, catalysts, monomers, their structure-reactivity relationships, elementary reactions, kinetics, and reaction mechanisms
Study Achievement Test (2)	1	To examine as "feed-back": The achievement of studying in the subjects that have already been discussed (ionic and living polymerizations).

【Textbook】None in particular. PDF files of slides that are to be shown at the course lectures will be uploaded into the course website, and it is strongly recommended for students to download these materials for review and self-learning.
【Textbook(supplemental)】"Fundamentals in Polymer Science", Tokyo Kagaku Dojin:
【Prerequisite(s)】Fundamental Polymer Science I (2nd year, 2nd term) and Fundamental Polymer Science II (3rd year, 1 st term)
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【Web Sites】
【Additional Information】

71290

Chemical Biology

化学生物学

【Code】71290 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2 【Restriction】No Restriction

【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Eiraku and Ohgushi (Institute for Frontier Life and Medical Sciences)

【Course Description】It is important in the field of life science to understand biochemistry and biological medicine in terms of organic material chemistry. The way to think and view the biological system and bioprocess at the molecular level can make clear the academic knowledge of life science and contribute to the development of engineering-medicine-pharmacy interdisciplinary research area. In this lecture, proteins, polysaccharides, and lipids of bio-related substances as well as cells, cell membrane, extracellular matrix of biological system are explained in terms of chemical biology. As a representative of engineering-medicine-pharmacy interdisciplinary research area, drug delivery system (DDS) and regenerative medicine are introduced. In addition, some topics in the field of life science, including stem cells, body defense and immunology, and endocrine disruptor, are also covered.

【Grading】The credit is judged by the scheduled examination and the attendant rate.

【Course Goals】The objective of the lecture is to obtain the fundamental knowledge of proteins, polysaccharides, lipids, cells, and extracellular matrix and understand stem cells, body defense, DDS, regenerative medicine, and endocrine disruptor of life science application.

【Course Topics】

Theme	Class number of times	Description
Proteins and enzymes	2	Structure and function of proteins and enzymes
Polysaccharides and lipids	1	Structure and function of polysaccharides and lipids
Cell and cell membrane	1	Structure and function of cells and membrane transportation
Signal transduction	1	Signal transduction at cell membrane
Energy conversion	1	Oxidative phosphorylation to generate ATP
Cytoskeleton	1	Cellular biomechanics and biochemistry of cytoskeleton
Body defense and immunology	1	System and function of body defense and immunology
Stem cells	1	System, function, and medical application of stem cells
Cell and extracellular matrix	1	Structure and function of extracellular matrix
Regenerative medicine and material science	2	Overview of regenerative medicine based on material science
Drug delivery system (DDS)	1	Overview of DDS based on material science
Endocrine disruptor	1	Overview of endocrine disruptor based on material science
Achievement evaluation	1	Credit evaluation based on the understanding level of lecture contents

【Textbook】

【Textbook(supplemental)】Fundamentals of Biochemistry: Life at the Molecular Level；Wiley 、
Molecular biology of the Cell ；Garland Science 、
ますます重要になる細胞周辺環境（細胞ニッチ）の最新科学技術；株式会社メディカルドゥ 、
Immunology；Saunders 、
生物薬剤学；株式会社南江堂 、
絵で見てわかるナノ DDS；株式会社メディカルドゥ

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

74040

Organic Material Synthetic Chemistry

材料有機合成化学

【Code】74040 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Seijiro Matsubara, Takuya Kurahashi

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2	
	4	
	4	
	1	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71340

Polymer Chemistry II

高分子化学 II

【Code】71340 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Mikihito Takenaka, Hiroki Ogawa

【Course Description】

【Grading】Grading

【Course Goals】Mastering at least the minimum knowledge of polymer physics necessary for starting research in polymer field

【Course Topics】

Theme	Class number of times	Description
polymer structure and characteristic property	3	Definition of polymer, polymer characteristics, kinds of polymer, molecular structure, shape of a single-chain and its variety, molecular weight and molecular weight distribution will be discussed.
	4	
	4	
	3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71370

Scientific English (Frontier Chemistry)

科学英語（創成化学）

【Code】71370 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】English 【Instructor】Seijiro Matsubara, Francesco Bolstad

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	4	
	4	
	5	

【Textbook】None

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

71270

Frontier Chemistry (Frontier Chemistry)

化学のフロンティア（創成化学）

【Code】71270 【Course Year】4th year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Frontier in Inorganic Chemistry	2	
Frontier in Polymer Material Chemistry	2	
Frontier in Organic and Analytical Chemistry	2	
Frontier in Polymer Design	2	
Frontier in Polymer Synthesis	2	
Frontier in Polymer Characterization	2	
Frontier in Polymer Physics	2	
Feedback	1	

【Textbook】None in particular.

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72000

Physical Chemistry I (Fundamental Chemistry)

物理化学 I （工業基礎化学）

【Code】72000 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Shu Seki, Kentaro Teramura

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	3	
	2	
	3	
	4	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72010

Inorganic Chemistry I (Fundamental Chemistry)

無機化学 I（工業基礎化学）

【Code】72010 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Takeshi Abe, Tetsuo Sakka, Ryu Abe, Toshiyuki Nohira, Tomokazu Fukutsuka, Saburo Hosokawa, Toshiaki Matsui

【Course Description】In "Inorganic Chemistry I", following four topics will be explained: 1) Acids and bases of inorganic compounds 2) Oxidation and reduction 3) Concept of group theory, which is necessary for the understanding of molecular structures 4) Fundamentals of d-block coordination compounds

【Grading】Grading is based on the examination held at the end of the semester. The attendance rate and the reports submitted during the course may be counted in evaluation.

【Course Goals】Acids and bases, oxidation and reduction, a group theory, and coordination compounds will be understood for Inorganic chemistry II at 3rd grade and Electrochemistry at 4th grade.

【Course Topics】

Theme	Class number of times	Description
Asids and Bases	4	Bronstead acids and bases and the Lewis acids and bases will be described. Hard and Soft Acids and Bases (HSAB) theory by Peason will be explained. Finally, solvent parameters which can evaluate the degree of intensities of acids and bases will be described.
Oxidation and Reduction	4	Oxidation and Reduction will be explained mainly by using electrochemistry. In particular, stand ard potentials will be explained in detail. By using the potentials, oxidation and reduction reactions will be explained.
Molecular Symmetry	4	Based on the molecular shapes, point groups can be determined. By using point groups, various physical phenomena of molecules will be described.
Coordination compounds	2	Coordination compounds based on metal ions of Lewis acids and ligands of Lewis bases will be described and their geometrical structures will be explained.
Evaluation	1	Evaluaion

【Textbook】Inorganic Chemistry (6th edition) M.Weller、T.Overton、J.Rourke、F.Armstrong(2014) ISBN 9780199641826

【Textbook(supplemental)】Supplemental explanation will be delivered at the first class.

【Prerequisite(s)】Based on the understanding of "Fundamental Inorganic Chemistry", lectures will be done.

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【Web Sites】

【Additional Information】Before the class, each topic should be prepared. At every class, quizes will be given and the answers for them should be submitted at the next class.

72020

Analytical Chemistry I (Fundamental Chemistry)

分析化学 I（工業基礎化学）

【Code】72020 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】T. Sakka, T Abe, T. Nohira, Y. Oki, N. Nishi, Y. Kobayashi

【Course Description】The solution equilibria that are important not only for introductory analytical chemistry but also for the fundamentals of chemistry, in general, such as acid-base equilibrium, complex formation, precipitation, and oxidation-reduction equilibrium, are the subjects of this course.

【Grading】Grading is based on the examination held at the end of the semester. The attendance rate and the reports submitted during the course may be counted in evaluation.

【Course Goals】Not only the understanding of the basics of solution equilibria and the capability of solving related problems, but the appreciation of the relationship of the solution equilibria with other disciplines of chemistry and science, in general, will be targeted.

【Course Topics】

Theme	Class number of times	Description
Intriduction to chemical equilibrium	2	
Acid-base equilibrium	5	
Precipitation equilibrium	1	
Complexation equilibrium	2	
Oxidation-recduction equilibrium	4	
Evaluation	1	

【Textbook】Daniel C. Harris, Quantitative Chemical Analysis, 9th ed., Freeman (2016)

【Textbook(supplemental)】

【Prerequisite(s)】None

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【Web Sites】

【Additional Information】

72030

Organic Chemistry I (Fundamental Chemistry)

有機化学 I (工業基礎化学)

【Code】72030 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese
【Instructor】Kouichi Ohe, Masaharu Nakamura, Tomoya Miura
【Course Description】
【Grading】
【Course Goals】
【Course Topics】

Theme	Class number of times	Description
Structure of Molecules and Organic Reactions (Chs 4 and 5)	1	
Nucleophilic Addition to the Carbonyl Group (Ch 6)	2	
Delocalization and Conjugation (Ch 7)	2	
Acidity, Basicity, and pKa (Ch 8)	2	
Using Organometallic Reagents to Make C-C Bonds (Ch 9)	1	
Nucleophilic Substitution at the Carbonyl Group (Ch 10)	2	
Nucleophilic Substitution at C=O with Loss of Carbonyl Oxygen (Ch 11)	2	
Determining Organic Structures Using Spectroscopies (Chs 3 and 13)	2	
assessing a student's level of attainment	1	

【Textbook】
【Textbook(supplemental)】
【Prerequisite(s)】
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【Web Sites】
【Additional Information】

72040

Mathematical Method in Chemistry I (Fundamental Chemistry)

化学数学 I (工業基礎化学）

【Code】72040 【Course Year】2nd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】 【Language】Japanese 【Instructor】Akihiro Ito, Ryoichi Fukuda

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	6	
	3	
	1	
	7	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

72250

Chemical Basis of Life (Fundamental Chemistry)

生命化学基礎 (工業基礎化学）

【Code】72250 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Masato Umeda, Itaru Hamachi, Yasuo Mori, Haruyuki Atomi, Shigeki Kiyonaka, Masayuki Mori, Yuji Hara, Tamotsu Kanai

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	2	
	3	
	3	
	3	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72230

Fundamental Chemistry Laboratory I(Fundamental Chemistry)

工業基礎化学実験 I（工業基礎化学）

【Code】72230 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】7 【Restriction】

【Lecture Form(s)】Exercise 【Language】Japanese 【Instructor】,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	18	
	18	
	18	
	11	
	7	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72240

Fundamental Chemistry Laboratory II(Fundamental Chemistry)

工業基礎化学実験 II（工業基礎化学）

【Code】72240 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】7 【Restriction】

【Lecture Form(s)】Exercise 【Language】Japanese 【Instructor】,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	18	
	18	
	11	
	7	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

72070

Physical Chemistry II (Fundamental Chemistry)

物理化学 II（工業基礎化学）

【Code】72070 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Hirofumi Sato, Akihiro Ito, Tohru Sato, Norikazu Mizuochi

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2	
	2	
	2	
	1	
	1	
	1	
	2	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

72080

Organic Chemistry II (Fundamental Chemistry)

有機化学 II (工業基礎化学)

【Code】72080 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】 【Language】Japanese 【Instructor】Michinori Suginome, Yasujiro Murata, Tetsuaki Fujihara

【Course Description】This course is designed for student who already learned basic organic chemistry. This course consists of three major parts. The first part concerns stereochemistry of organic compounds and reactions. The second part focuses on the reaction of saturated organic compounds bearing leaving groups. Nuceophilic substitution and elimination are involved in this part. The third part gives the details of the reactivities of unsaturated organic compounds bearing p-electrons such as alkenes, enols, enolates, and aromatic compounds.

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Stereochemistry	2	Enantiomers; Diastereomers; Chiral compounds devoid of chiral centers; Symmetry, Optical resolution (Chapter 14)
Nucleophilic Substitution	3	Mechanism; SN1 and SN2 reactions; Leaving group; Nucleophiles; Elimination and Rearrangement (Chapter 15)
Elimination	2	Effect of Nucleophiles on Elimination and Substitution; E1 and E2 Elimination; Role of leaving group; Stereochemistry of elimination; E1cB reaction (Chapter 17)
Electrophilic Addition to Alkenes	3	Bromination, Epoxidation; Regio- and stereochemistry of electrophilic addition; addition to conjugated dienes; Mechanism, Halolactonization (Chapter 19)
Formation and Reaction of Enols and Enolate	2	Keto-enol Tautomerization; Acid- and base-catalyzed enolization; Stable enols; Reactions involving enols and enolates as intermediates; Stable enolate equivalents; Reaction at the oxygen atoms of enol and enolate; Reactions of enol ethers (Chapter 20)
Aromatic Electrophilic Substitution	2	Electrophilic substitution of benzene, phenol, and anilines; ortho/para and meta preferences (Chapter 21)
Examination	1	

【Textbook】Organic Chemistry (Second Edition; Clayden, Greeves, Warren; Oxford University Press: 2012)

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

72090

Inorganic Chemistry II (Fundamental Chemistry)

無機化学 II (工業基礎化学)

【Code】72090 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Takeshi Abe, Fumiyuki Ozawa,Takashi Uemura, Koji Miki, Hiroshi Takatsu

【Course Description】Inorganic Chemistry II is an advanced course after learning Basic Inorganic Chemistry and Inorganic Chemistry I.
Structures, electronic spectra and reaction mechanism in coordination chemistry of metal complexes and organometallic compounds are lectured.

【Grading】Grades based on attendance and a final exam.

【Course Goals】Understanding of the basis of steric structure, electronic structure, electronic spectra and reaction mechanism in metal complexes and organometallic compounds

【Course Topics】

Theme	Class number of times	Description
19. d-Metal complexes: electronic structure and spectra	7	
20. Coordination chemistry: reactions of complexes	4	
21. d-Metal organometallic chemistry	3	
Lecture review	1	

【Textbook】Shriver and Atkins Inorganic Chemistry [4th edition, Tokyo Kagakudojin] P.W.Atkins T.L.Overton J.P.Rourke M.T.Weller F.A.Armstrong, (translators) K.Tanaka, K.Hirao, S.Kitagawa

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】d-Metal complexes, Electronic spectra, Steric structure and reaction mechanism of coordination compounds, Organometallic compounds

72100

Analytical Chemistry II（Fundamental Chemistry）

分析化学 II（工業基礎化学）

【Code】72100 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Takeshi Abe, Tsutomu Ohtsuki, Hironori Kaji, Naoya Nishi, Masayuki Mori, Koichi Takamiya

【Course Description】As an introductory course of instrumental analysis, the lectures on chromatography, spectroscopy, electroanalytical chemistry, and mass spectrometry, will be given,

【Grading】Grading will be mainly based on the score of the examination at the end of the semester. Attendance rate and the reports submitted may also be considered in evaluation.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Chromatography	3	
Spectroscopy	4	
Electroanalytical Chemistry	3	
Mass spectroemtry	2	
	1	
	2	

【Textbook】Daniel C. Harris, Quantitative Chemical Analysis (W. H. Freeman, 8th-ed., 2010)

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72110

Introduction to Green Chemistry

グリーンケミストリー概論

【Code】72110 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Koichi Eguchi, Masahiro Murakami, Satoshi Hashimoto

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	5	
	5	
	5	
	4	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72120

Basic Biochemistry I(Fundamental Chemistry)

生化学 I（工業基礎化学）

【Code】72120 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Yasuo Mori, Itaru Hamachi, Haruyuki Atomi, Masato Umeda, Masayuki Mori, Yuji Hara, Tamotsu Kanai

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2	
	2	
	1	
	2	
	2	
	1	
	1	
	1	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72130

Introduction to Polymer Chemistry I (Fundamental Chemistry)

高分子化学概論 I (工業基礎化学)

【Code】72130 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Hideki Matsuoka, Takaya Terashima

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	3	
	1	
	3	
	2	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72200

Mathematical Method in Chemistry II

化学数学 II

【Code】72200 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】 【Language】Japanese

【Instructor】Tohru Sato, Norikazu Mizuochi, Hiroshi Nakano

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	1	
	3	
	1	
	4	
	3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72140

Organic Chemistry III (Fundamental Chemistry)

有機化学 III （工業基礎化学）

【Code】72140 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Tsuji, Kondo, Ohmura,
【Course Description】The lecture is given on Organic Chemistry which is indispensable to a researcher and an engineer. After the Organic Chemistry I (2nd year, 2nd term) and the Organic Chemistry II (3rd year, 1st term), the lecture is given on the chapters 22 - 26 of the same textbook, which covers characteristic reactions of electron-deficient alkenes and aromatic compounds, protection and deprotection of functional groups, and chemistry of carbonyl compounds including various reactivity of enolates.
【Grading】The grade is given based on the final examination.
Attendance and reports during the class could be considered.
【Course Goals】Comprehensive understanding of reactions of aromatic compounds, reactivities of functional groups, and chemistry of carbonyl compounds including alkylation of enolates, the aldol reaction, and other condensation reactions is a goal of this course. By combining ideas learned in the Organic Chemistry I and the Organic Chemistry II, high-level knowledge of organic chemistry must be acquired which is indispensable for a accomplished researcher and engineer.
【Course Topics】

Theme	Class number of times	Description
Conjugate addition and nucleophilic aromatic substitution	3	Conjugate addition reactions, conjugate substitution reactions, nucleophilic epoxidation, electrophilic aromatic substitution, addition-elimination mechanism, diazonium compounds, reactions via benzyne intermediate (Chapter 22)
Chemoselectivity and protecting groups	3	Reducing agents, reduction of carbonyl groups, catalytic hydrogenation, removal of functional groups, dissolving metal reductions, selectivity in oxidation reactions, reactivities of functional groups, protecting groups (Chapter 23)
Regioselectivity	2	Regioselectivity in electrophilic aromatic substitution reactions, electrophilic attack on alkenes, regioselectivity in radical reactions, nucleophilic attack on allylic compounds, electrophilic attack on conjugated dienes, direct addition vs. conjugate addition (Chapter 24)
Alkylation of enolates	3	Alkylation of nitriles and nitroalkanes, electrophiles for alkylation, alkylation of lithium enolates, alkylation using enolate equivalents, alkylation of beta-dicarbonyl compounds, regioselectivity in alkylation of ketones (Chapter 25)
Reactions of enolates with carbonyl compounds: the aldol and Claisen reactions	3	The aldol reaction, cross aldol condensation, aldol reactions using enolates and their equivalents, intramolecular aldol reaction, acylation of enolates, Claisen condensation, cross Claisen condensation, intramolecular cross Claisen condensation (Chapter 26)
	1	
	1	

【Textbook】Organic Chemistry Second Edition (J. Clayden, N. Greeves, S. Warren, Oxford University Press, 2012)
【Textbook(supplemental)】マクマリー 有機化学 ー生体反応へのアプローチ（マクマリー著；柴崎正勝，岩澤伸治，大和田智彦，増野匡彦　監訳；東京化学同人 , 2009）
【Prerequisite(s)】Basic Organic Chemistry A, Basic Organic Chemistry B, Organic Chemistry I(Fundamental Chemistry), Organic Chemistry II(Fundamental Chemistry)
【】
【Web Sites】
【Additional Information】Two classes are lectured at the same time.

72150

Physical Chemistry III (Fundamental Chemistry)

物理化学 III（工業基礎化学）

【Code】72150 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Kenji Matsuda, Masahiro Shirak, Tomokazu Umeyama, Kenji Sugase

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	4	
	2	
	3	
	3	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72160

Inorganic Chemistry III (Fundamental Chemistry)

無機化学 III（工業基礎化学）

【Code】72160 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese
【Instructor】Prof. KAGEYAMA Hiroshi, Graduate School of Engineering
Prof. EGUCHI Koichi,, Graduate School of Engineering
Assoc. Prof. TAKAI Shigeomi, Graduate School of Energy Science
Prof. MIZUOCHI Norikazu, Institute for Chemical Research

【Course Description】This class deals with the topics related to inorganic solids, such as synthesis methods, structures, and properties
【Grading】Grading will be determined by a term-end examination
【Course Goals】Goal of the class is to understand the synthesis method and characterization of inorganic solids, crystals structure, crystallography and diffraction techniques, phase diagrams, crystal defects, non-stoichiometry, solid solutions, and bonding in solids.
【Course Topics】

Theme	Class number of times	Description
Synthesis method	2	Solid state reaction, gas phase methods, liquid phase methods, intercalation, electrochemical methods, single crystal growth, and hydrothermal methods will be lectured.
Characterization of solids	2	The characterization of solids will be lectured, such as optical microscope, electron microscope, IR spectroscopy, Raman spectroscopy, NMR, XAFS, and thermal analysis.
Crystal Structure	2	Symmetry in crystals will be lectured from the point view of the crystal structures.
Crystallography and diffraction techniques	2	Crystallography and x-ray diffraction methods will be lectured.
Phase diagrams	2	Phase diagrams including actual chemical compounds and their interpretations will be lectured.
Crystal defects, non-stoichiometry, solid solutions	2	Solid solution, several types of the defects in solids will be lectured.
Electrical properties	2	Metallic conductivity, superconductivity, semiconductivity, and ionic conductivity will be lectured.
Term-end examination	1	Understanding of this class will be examined.

【Textbook】Solid State Chemistry and its Applications (2nd Edition, Wiley), A. R. West
The following textbooks are also allowed.
Basic Solid State Chemistry (Second Edition), A.R.West, John Wiley &Sons (1999)
ウエスト固体化学入門（講談社）
【Textbook(supplemental)】
【Prerequisite(s)】
【】
【Web Sites】
【Additional Information】Homework is to read the textbook before the class and to solve the problem.

70641

Basic Biochemistry II

生化学 II

【Code】70641 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Yasuo Mori, Itaru Hamachi, Haruyuki Atomi, Masato Umeda, Masayuki Mori, Yuji Hara, Tamotsu Kanai

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	3	
	2	
	2	
	2	
	2	
	1	
	4	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72170

Introduction to Polymer Chemistry II (Fundamental Chemistry)

高分子化学概論 II（工業基礎化学）

【Code】72170 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese
【Instructor】H. Watanabe (ICR), H. Kaji (ICR), Y. Matsumiya (ICR), K. Shizu (ICR), and K.Suzuki (ICR)
【Course Description】Characteristic structures (such as crystalline and amorphous structures) and characteristic properties (such as viscoelasticity) of polymers result from the thread-like primary structure of polymer molecules. Focusing on this point, this lecture addresses the structures and properties of polymers in solutions, in melts, and in solids.
【Grading】Judged on the basis of home-work reports and the final exam.
【Course Goals】To understand molecular origin(s) of the characteristic structures, dynamics, and properties of polymers.
【Course Topics】

Theme	Class number of times	Description
Conformation of Polymer Chain	2	The conformation distribution of flexible polymers and the relationship between their average size and molecular weight are explained.
Solution Properties	3	The thermodynamic behavior of polymer solutions, such as the osmotic pressure and phase separation,is explained on the basis of the Flory-Huggins theory. For this purpose, molecular expressions are derived for the mixing entropy, mixing enthalpy, and chemical potential. In addition, a brief introduction is given for methods of molecular weight determination on the basis of the solution properties.
Structure in Solid State	2	Various morphology of crystalline polymers, i.e., single crystal, spherulite, lamellar crystalline, and extended chain crystal, are introduced and basic crystallization processes giving this variety of morphology are explained. In addition, methods of analysis of these crystalline structures are intriduced and the results of the analysis are explained.
Glass Transition	1	The glass transition phenomenon is explained in relation to the thermal motion of polymer chains. Changes of the thermal and mechanical properties on this transition are explained are related to the motion of the polymer chains.
Rubber Elasticity	2	From a molecular point of view, the conformation distribution of flexible polymer chains above the glass transition point is related to the rubber elasticity. The molecular expression is derived for the stress and modulus of rubbers.
Polymer Dynamics	4	The viscoelastic behavior of flexible polymer melts is related to the large scale motion of the polymer chains. In particular, the entanglement effect due to the uncrossability of the chains is explained from a molecular point of view, and some basic models are introduced. In addition, for polymers having type-A dipoles parallel along the chain backbone, a relationship between viscoelastic and dielectric properties is explained.
Summary	1	Essence of the whole lecture and a relationship among all items in the lecture are summarized, thereby improving the understanding of the attending students in particular for the items not well addressed in the the exams.

【Textbook】Printed documents are distributed in the class.
【Textbook(supplemental)】Shin Kobunshi Kagaku Joron (a book published from Kagaku Dojin)
Kobunshi no Kouzou to Bussei (a book published from Koudansha) ISBN978-4-06-154380-5
【Prerequisite(s)】The students taking this class are desired to learn the basic part of polymer science at the class "Introduction to Polymer Chemistry I (Fundamental Chemistry)".
【】
【Web Sites】
【Additional Information】

70520

Introduction to Quantum Chemistry

量子化学概論

【Code】70520 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Prof. SATO Hirofumi, Graduate School of Engineering

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	1	
	2	
	2	
	3	
	2	
	2	
	1	
	4	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72260

Scientific English (Fundamental Chemistry)

科学英語（工業基礎化学）

【Code】72260 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】English

【Instructor】Yasuo Mori, Masahiro Shirakawa, Yasushi Miki, Francesco Bolstad

【Course Description】To understand scientific and technological English, and to learn how to express your ideas in English, especially English for practical use in the field of science and technology.

【Grading】Regular easy reports.

【Course Goals】To play an active role internationally as scientists and engineers, an ability for expressing things in "practical" English is gained through understanding the way to write and explain backgrounds, questions, object, methods, results, discussion of the study in English.

【Course Topics】

Theme	Class number of times	Description
	1	Workshop and talk with a native speaker.
	4	To understand methods of expression in scientific papers and reports.
	4	Technical writing.
	5	Short presentations.

【Textbook】None

【Textbook(supplemental)】N/A

【Prerequisite(s)】

【】N/A

【Web Sites】N/A

【Additional Information】Available according to students' requests.

70610

Catalyst Chemistry

触媒化学

【Code】70610 【Course Year】4th year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Ryu Abe, Koichi Eguchi, Tsunehiro Tanaka, Kentaro Teramura

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	2	
	2	
	1	
	1	
	2	
	2	
	1	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72180

Statistical Mechanics for Chemistry (Fundamental Chemistry)

化学統計力学（工業基礎化学）

【Code】72180 【Course Year】4th year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】 【Language】Japanese

【Instructor】Seki, Shuhei, Graduate School of Engineering

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	1	
	2	
	1	
	3	
	3	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72220

Organic Chemistry IV (Fundamental Chemistry)

有機化学 IV（工業基礎化学）

【Code】72220 【Course Year】4th year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Koji Miki, Aiichiro Nagaki

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	2	
	2	
	2	
	2	
	1	
	2	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

72190

Frontiers in Instrumental Analytical Science

先端機器分析科学（工業基礎化学）

【Code】72190 【Course Year】4th year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】 【Language】Japanese 【Instructor】,

【Course Description】Advanced instrumental methods in analytical chemistry will be delivered.

【Grading】The attendance rate and the reports submitted will be considered in evaluation.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Introduction to advanced instrumental analysis	1	
Highly functionalized column packing and its application to separation analysis	4	
Fundamentals and applications of advanced X-ray absorption analysis	4	
Fundamentals and applications of pH meters	6	

【Textbook】None

【Textbook(supplemental)】None

【Prerequisite(s)】Analytical Chemistry I and II are highly recommended.

【】

【Web Sites】

【Additional Information】

73000

Physical Chemistry I (Chemical Enginnering)

物理化学 I（化学工学）

【Code】73000 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】【Language】Japanese 【Instructor】K. Mae, T. Maki, K. Tanabe

【Course Description】Thermodynamics is an essential subject to learn chemical engineering. This class provides an elementaly level of chemical engineering thermodynamics.

【Grading】The score is evaluated by reports (homeworks) and examinations.

【Course Goals】The goal is to learn the way to apply the basics of thermodynaaics to chemical process caluculations.

【Course Topics】

Theme	Class number of times	Description
Introduction	0.5	
The First Low of Thermodynamics and Other Basic Concepts	0.5	
Volumetric Properties of Pure Fluids	1.5	
Thermochemistry	1.5	
The Second Low of Thrmodynamics	2	
Confirmation of the Level of Attainment 1	1	
Balance for Open Systems	2	
Thermodynamic Properties of Fluids	2	
Phase Equilibrium	1	
Application of Thermodynamics to Industrial Processes	2	
Confirmation of the Level of Attainment 2	1	

【Textbook】J. M. Smith and H. C. Van Ness : Introduction to Chemical Engineering Thermodynamics, Eighth Edition (McGraw-Hill International)

【Textbook(supplemental)】

【Prerequisite(s)】The basic knowledge of physical chemistry is required.

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【Web Sites】

【Additional Information】

73140

Material and energy balances

化学工学量論

【Code】73140 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】K. Mae, M. Kawase, T. Maki, K. Tanabe

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	3	
	2	
	2	
	2	
	3	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

73010

Inorganic Chemistry I (Chemical Engineering)

無機化学 I（化学工学）

【Code】73010 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Takeshi Abe, Tetsuo Sakka, Ryu Abe, Toshiyuki Nohira, Tomokazu Fukutsuka, Saburo Hosokawa

【Course Description】In "Inorganic Chemistry I (Chemical Engineering)", following five topics will be explained: 1) Acids and bases of inorganic compounds 2) Oxidation and reduction 3) Concept of group theory, which is necessary for the understanding of molecular structures 4) Fundamentals of coordination compounds, 5) Corrosion

【Grading】Grading is based on the examination held at the end of the semester. The attendance rate and the reports submitted during the course may be counted in evaluation.

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Asids and Bases	4	
Oxidation and Reduction	4	
Corrosion	3	
Molecular Symmetry	4	
Coordination compounds	2	
Evaluation	1	

【Textbook】Inorganic Chemistry (4th edition) P. Atkins、T. Overton、J. Rourke、M. Weller、F. Armstrong

【Textbook(supplemental)】Supplemental explanation will be delivered at the first class.

【Prerequisite(s)】Based on the understanding of "Fundamental Inorganic Chemistry", lectures will be done.

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【Web Sites】

【Additional Information】

74010

Fundamental Fluid Mechanics

基礎流体力学

【Code】74010 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Takashi Taniguchi
【Course Description】Lecture on fundamentals of fluid dynamics needed for Chemical Engineering
【Grading】Grade will be determined by (i) the examination at the end of semester and (ii) homeworks during semester.
【Course Goals】Goal of this class is to understand the fundamental pricipals in fluid dynamics.
【Course Topics】

Theme	Class number of times	Description
Introduction to fluid dynamics	3	0. Example of flows 0-1. flow of ideal fluid 0-2. Laminar flow 0-3. Stability of flow 0-4. Turbulent 0-5. Computational fluid dynamics 1. Properties of fluid 1-1. Viscosity 1-2. Compressibility 1-3. Laminar and turbulent flows 2. Quiescent fluid 2-1. Pressure 2-2. Buoyancy
Dynamics of Ideal Fluid	6	3. Fundamentals on flows 3-1. Particles and continuum body 3-2. One dimensional flow 3-3. Three dimensional flow (Preparation of Mathematics) 4-1. Mechanics in the ideal fluid 4-2. Equation of continuity 4-3. Euler's equation of motion 4-4. Bernoulli's theorem 4-5. Examples 4-6. Streaming function and potential flow
Dynamics of viscous fluid	5	5. Dynamics of viscous fluid 5-1. Viscosity 5-2. Stress tensor 5-3. Exact soluble problems described by Navier-Stokes equation
Confirmation of the level of attainment	1	Confirmation of the level of attainment Comments on the term-end Exam

【Textbook】
【Textbook(supplemental)】Bird, Stewart, Lightfoot "Transport Phenomena 2nd Ed." (Wiley)
【Prerequisite(s)】It is highly recommended for students to take the class: "Mathematics for Chemical Engineers I".
【】
【Web Sites】http://www-tph.cheme.kyoto-u.ac.jp/p/taniguch/class.html
【Additional Information】

73020

Mathematics for Chemical Engineering I (Chemical Engineering)

化学工学数学Ⅰ(化学工学)

【Code】73020 【Course Year】2nd year 【Term】2nd Semester

【Class day & Period】Thursday, the first period class 【Location】W4 Room 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture and Practice 【Language】Japanese

【Instructor】Takashi Taniguchi, Shinsuke Nagamine

【Course Description】The aim of this class is to learn the fundamental mathematics commonly used in Chemical Process Engineering, Chemical System Engineering, such as ordinary differential equations, Laplace transformation, methods to solve differential equations by using Laplace transformation, and vector analysis. The style of the class is mainly lecture style.

【Grading】Grade will be evaluated by (i) the examination at the end of semester and (ii) homework during semester.

【Course Goals】To attain the mathematical knowledge and skill how to solve ordinal differential equations by using Laplace transformations

【Course Topics】

Theme	Class number of times	Description
Vector Analysis	7	We learn the following items: Vector Analysis (including differentiation of vectors), Integration of vectors Integral Theorem (Gauss divergence Theorem, Stokes Theorem)
Ordinary differential Equation	4	We learn that various physical phenomena seen in our daily life can be described by ordinary differential equations. As method to solve 1st and 2nd order ordinary differential equation, the following methods will be learned : 1. Method of separation of variables 2. Method of variation of parameters
Laplace Transformation	3	After learning the historical background and the discovery of Laplace transformation. We learn how to solve ordinal differential equations and integral equations by using Laplace transformation, and also learn applications of Laplace transformation to definite integration.
Confirmation of the level of attainment	1	Confirmation of the level of attainment Comments on the term-end Exam

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】Basic knowledge on differentiation, integral, matrix operations

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【Web Sites】

【Additional Information】

74020

Computer Programming in Chemical Engineering

化学工学計算機演習

【Code】74020 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】 【Language】Japanese

【Instructor】Motoaki Kawase, Ryuichi Ashida

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	2	
	3	
	3	
	1	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

74030

Chemical Reaction Engineering I

反応工学 I

【Code】74030 【Course Year】2nd year 【Term】2nd semester 【Class day & Period】Friday 【Location】W201

【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture and practice 【Language】Japanese

【Instructor】Prof. Motoaki Kawase, Associate Prof. Hiroyuki Nakagawa

【Course Description】Homogeneous chemical reaction engineering including kinetic analysis, design and operation of reactors, complex reactions, recycle reactors, semibatch operation, and nonisothermal reactors.

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Design equations of isochoric and nonisochoric reactors	1	
Reactor systems	2	
Complex reactions	4	
Kinetic analysis of reactions and design and operation of reactors	2.5	
Nonisothermal reactors	4.5	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

Transport Phenomena

移動現象

【Code】70460 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Prof. Ryoichi Yamamoto, Graduate School of Engineering

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	5	
	5	
	4	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

73030

Fluid-Phase Separation Engineering

流体系分離工学

【Code】73030 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese
【Instructor】Noriaki Sano, Taisuke Maki
【Course Description】Chemical Processes consist of variety of units and operations. Here, distillation, gas absorption, extraction, and so forth which aim substance separation and purification will be lectured from basic principle and phenomena to kinetics and quantitative expression.
【Grading】Evaluation will be made based on midterm exam, routine exam at the end of semester, and reports often given in lectures.
【Course Goals】By taking typical separation operations as examples, mass balance, the students will understand the concept of mass transfer, and equilibrium, and they will master how to use them in quantitative manner. Additionally, they cultivate their ability to use differential contact operation and stage operation.
【Course Topics】

Theme	Class number of times	Description
Fundamental of mass separation and mass purification	3	Principles and methods in substance separation and purity, which are important for chemical process, will be lectured. Fundamentals of molecular diffusion and mass transport will be explained.
gas absorption	4	Equilibrium of gas with liquid, diffusion in liquid phase, gas diffusion rate, and design of gas absorption will be lectured, and the students will understand the idea of differential contact operation.
distillation	4	Method to correlate the gas-liquid equilibrium will be lectured, and fundamental principle of distillation operation is explained as operation for purification of liquid mixture. The design method of continuous rectifying trays tower will be lectured as the most simple multi-stage contact operation method.
extraction	3	Method to correlate the gas-liquid equilibrium will be lectured, and fundamental principle of distillation operation is explained as operation for purification of liquid mixture. The design method of continuous rectifying trays tower will be lectured as the most simple multi-stage contact operation method.
Feedback class	1	A supplementary lecture or exercise class will be conducted as an additional class to give advanced knowledge or to confirm the attainment level of the course goals on diffusion, gas absorption and distillation.

【Textbook】"Gendai Kagaku Kogaku," K. Hashimoto and F. Ogino (Sangyo Tosho)
"Kanso Gijutu Jitsumu Nyumon," H. Tamon (Nikkan Kogyo Shinbun)
【Textbook(supplemental)】"Kagakukikai no Riron to Keisan," S. Kamei (Sangyo Tosho)
【Prerequisite(s)】Introduction to Industrial Chemistry (Material and energy balances), Fundamentals of Chemical Process Engineering,
【】
【Web Sites】
【Additional Information】Lecture will be given basen on the textbook. Exercise problems will be given to students to deepen understanding in due course.

70480

Process Control

プロセス制御工学

【Code】70480 【Course Year】3rd year 【Term】2018・1st semester 【Class day & Period】Wednesday・2nd Period 【Location】W201/The 1st seminar room 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Graduate School of Engineering, Professor Shinji Hasebe, Professor Masahiro Ohshima, Assistant Professor, Sanghong Kim

【Course Description】Process control is used for operating the production processes in chemical and the steel industries. Pressure, temperature, liquid level and flow rate are major process variables to be controlled automatically (i.e., computers). Understanding the process dynamics is the first step to develop a good control system. Then, as the second step, the optimal selection and manipulation of the process input variables has to be determined. The class teaches to derive the physico-chemical dynamic models of chemical processes and transfer function models, which are obtained by taylor expansion of the physico-chemical models. Then, the design scheme of controller is described. To make the understanding easier, computer simulation exercises using Matlab and Simulink are offered. 1.

【Grading】The score is determined by considering the quality of homeworks, midterm exam, term-end exam and final project.

【Course Goals】The goal of the class is to educate the students to be able to develop the dynamic process model, design the process controller and to analyze the control performance so as to design the optimal process control systems.

【Course Topics】

Theme	Class number of times	Description
Introduction of Process Control	1	Showing several examples, the necessity, objectives and importance of process control are described. Then, the concepts of feedback and feed-forward controls and technical terms on process control are explained. Some issues on process control design are explained. The basic design procedure of the control system for solving the issues is explained.
Development of Dynamic Models	1	The first step for developing better process control systems is to understand the dynamic behaviors of the process to be controlled. The modeling method using the material and heat balance equations is lectured to construct the model showing the dynamic behavior of the process appropriately. Then, how to derive the linear transfer model using Taylor expansion of the first principle model is explained.
Laplace transform and Transfer function	1	The Laplace transform is revisited first. Then, how to derive the transfer function from the linearized dynamic model among the input and the output variables is lectured. How to obtain the linear model from the step response is also taught.
Exercise with Matlab for learning dynamic behavior	1	[Exercise] After learning the basics of Matlab and Simulink, the dynamic behaviors of some typical dynamic systems such as the first-order lag system and the second-order lag system are simulated. Then, for a given process, the exercise on developing the model and executing the simulation is executed.
PID Control	1	The most popular controller in process industries is PID (Proportional, Integral, and Derivative) controller. The basic features of three elements (P, I, D) are explained. Then, after explaining the basic feature of PID controller, how to adjust the control parameters is taught.
Dynamics of controlled system	1	The relationship between the pole of the transfer function and the stability is lectured. Then, the basic feature, the steady-state characteristics, and the stability of the feedback control system are explained.
Mid-term exam	1	To know the level of understanding, the mid-term examination is conducted.
Frequency response	1	The relationship between the sine wave input and the output (the frequency response), and how to detect the stability from the frequency response are lectured. The features of various filters are also explained.
PID control system design	1	The adjusting method of PID parameters based on the IMC control procedure is explained. Then, several revised controllers of the basic PID controller for improving the performance are lectured.
Exercise of control system design	1	[Exercise] For a given process, the exercise of tuning the control parameters and verifying the performance under the developed system using Matlab/Simulink is executed.
Cascade control and Multi-loop control	1	The concept of cascade control is explained. Then, as a control system dealing with the two-input and two-output process, the multi-loop control system is introduced, and how to remove the interaction among the control loops is explained.
Exercise of multi-loop control	1	[Exercise] For a given process, the exercise of developing a controller for a two-input and two-output process is executed.
Equipment for control	1	The equipment used for the real process control system are explained. The concept of proportional band and the reason why non-dimensional system is used are explained.
Overall exercise of process control design	1	[Exercise] Starting with the construction of the first principle model of a chemical/bio process, a two-input and two-output control system (multi-loop controller) is designed and the parameters are tuned by using Matlab and Simulink
Feed-back time	1	The question and answer to the final exercise, and the whole of the lectures are conducted.

【Textbook】Process Control Engineering, Hashimoto, Hasebe, Kano, Asakura book store,

【Textbook(supplemental)】Process Control System, Ohshima, CORONA Publishing

【Prerequisite(s)】Basic understanding of linear algebra, ordinal differential equations and Laplace transform

【】The final term project will be given.

【Web Sites】

【Additional Information】

73040

Physicsl Chemistry II (Chemical Engineering)

物理化学 II（化学工学）

【Code】73040 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Hideki Tanaka,Tetsuo Suzuki,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	8	
	6	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

73050

Mathematics for Chemical Engineering II

化学工学数学 II

【Code】73050 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese
【Instructor】Takashi Taniguchi, Shinsuke Nagamine
【Course Description】We will give a series of lectures on necessary mathematical knowledge and skills when students will learn subjects in the chemical engineering course, especially on Probability and Statistics, Fourier Transformation, Partial Differential Equations.
【Grading】Grading will be determined by a test at the end of series of lectures, and reports and short tests in class, if necessary.
【Course Goals】Goal of the class is that students attain necessary mathematical knowledge that is needed when students learn subjects in the chemical engineering course.
【Course Topics】

Theme	Class number of times	Description
Probability and Statistics (fundamentals)	5	1-1. Definition and properties of probability 1-2. Conditional probability 1-3. Stochastic variable and its properties (a) Probability distribution function, (b) Average, Expectation value, Moment, (c) Moment generating function 1-4. Multi-stochastic variable case (a) simultaneous distribution function (b) marginal and conditional probability (c) covariance, correlation coefficient
Probability and Statistics	2	1-5. Various distribution function (a) binomialdistribution functions (b) Poisson distribution functions (c) Gauss distribution functions 1-6. Law of large numbers Central limit theorem Normal distribution
Fourier Transformation	4	3-1. Euler's formula 3-2. Fourier integral 3-3. Fourier transformation
Partial Differential Equation	3	4. Fundamentals to solve partial differential equations Equation of wave Diffusion equation Multi-dimensional problem
Confirmation of the level of attainment	1	Confirmation of the level of attainment

【Textbook】
【Textbook(supplemental)】
【Prerequisite(s)】It is required that students have already had the lecture : Mathematics for Chemical Engineering I in the former semester.
【】
【Web Sites】
【Additional Information】

70820

Numerical Computation for Chemical Engineering

計算化学工学

【Code】70820 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】 【Language】Japanese
【Instructor】Masahiro Ohshima, Shinsuke Nagamine,
【Course Description】Solving several Chemical Engineering problems with computer language, Visual Basic (VBA) in Excel, the students earn the basic computational skills for engineering calculations. They will be learing how to solve the linear and nonlinear algebraic equations, differential equations, integral and linear and nonlinear least square method for parameter fittings
【Grading】The submission of all homework assignments will be worth 40% of the final grade. The term end exam will be evaluated for the rest of the 60 % of the final grade.
【Course Goals】The goals of this course is to write computer programming codes by students themselves for solving the simple Chemical Engineering Problems.
【Course Topics】

Theme	Class number of times	Description
How to solve the Algebraic Equation	1	After the orientation and introduction of class, the simple chemical engineering problems that can be formulated by algebraic equations are assigned to solve with VBA.
How to solve the differential equation	1	After learning the Euler, RKG methods for solving the differential equations, the students work on the calculation of chemical reactor.
How to integrate	2	After learning computer algorithm, like Simpson method, a calculation of a sedimentation and separation process is solved.
How to manipulative the matrix and vector	2	The programming codes for performing basic matrix calculations will be taught first, Then, the students will develop a computer program to derive a linear regression model from the data using the matrix calculation codes.
	1	
How to solve the partial differential equation	2	The scheme of approximating the partial differential equation with difference equations for computer calculation is taught.
non-linear least square method for parameter fittng	2	The students will learn Non-linear least square method after understading the steepest descent method and Newtonian method.
	3	
Exercise with some selected problem	1	Review the entire course and perform Question and Answer. Some selected chemical engineering problem may be given to exercise and self-score own computer programming skill.

【Textbook】Text will be prepared by the tutors
【Textbook(supplemental)】Exercise of Chemical Engineering Programming.
Programming for Chemical Engineering with Basic
【Prerequisite(s)】Excel is to be used. The basic operation of computer and excel is prerequisite.
【】
【Web Sites】
【Additional Information】The first 30 minutes of the class will be devoted for explaining theory and basic computational scheme needed to solve the assignment of the day. Then, Move to the computer room and solve the assignment by using the computer.

73120

Chemical Process Engineering Laboratory I(Chemical Engineering)

化学プロセス工学実験 I（化学工学）

【Code】73120 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】5 【Restriction】【Lecture Form(s)】Exercise 【Language】Japanese

【Instructor】Teaching staff in department of chemical engineering,

【Course Description】Experimental training on chemical analyses (gravimetric analysis, titration analysis) and fundamentals of chemical engineering (physical chemistry, transport phenomena, reaction engineering, etc.)

【Grading】Attendance, performance in experiments, reports will be evaluated.

【Course Goals】This course will enhance students’ understanding of quantitative chemical analysis and chemical engineering.

【Course Topics】

Theme	Class number of times	Description
Fundamentals on chemical analyses	15	training regarding glass tools, electric balance, condensation, filtration, volumetric measurement, titration, etc. Also study tour for Kyoto University Environmental Preservation Research Center is organized to learn waste liquid treatment.
Chemical Engineering I/Physical Chemistry	14	freezing point drop, precise measurement of liquid density and partial molar volume, Liquid-liquid equilibrium, gas-liquid equilibrium, measurement of gas diffusivity, fabrication of pH meter, surface tension and wettability
Chemical Engineering I/Transport Phenomena	4	viscosity and flow dynamics, pressure drop in liquid flow
Chemical Engineering I/Reaction Engineering	4	kinetic analysis in batch reactor, characterization of flow reactor
Chemical Engineering I/Apparatus Setup	2	electric-cooling temperature-controlled batch,

【Textbook】Textbook edited by teaching staff in department of chemical engineering

【Textbook(supplemental)】Bird, Stewart, Lightfoot, Transport Phenomena, 2nd Ed. (Wiley)
Hashimoto and Ogino, Gendai Kagaku Kogaku (Sangyo Tosyo)
Hashimoto, Hanno Kogaku (Baifukan)
Smith, Van Ness, Abbott, Introduction to Chemical Engineering Thermodynamics, 7th Ed.(McGraw Hill)

【Prerequisite(s)】Fundamentals of Chemical Process Engineering, Physical Chemistry I (Chemical Engineering), Fundamental Fluid Mechanics, Chemical Reaction Engineering I are recommend to take in advance.

【】

【Web Sites】

【Additional Information】

73130

Chemical Process Engineering Laboratory II(Chemical Engineering)

化学プロセス工学実験 II（化学工学）

【Code】73130 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】5 【Restriction】

【Lecture Form(s)】Exercise 【Language】Japanese

【Instructor】Teaching staff in department of chemical engineering,

【Course Description】Experimental training of chemical engineering fundamentals(transport phenomena, separation engineering, reaction engineering, powder technology, process control)

【Grading】Attendance, performance in experiments, reports will be evaluated.

【Course Goals】This course will enhance students’ understanding of chemical engineering, and the students will learn typical operations in the experiments.

【Course Topics】

Theme	Class number of times	Description
Chemical Engineering II/Transport phenomena	9	unsteady state heat transfer, heat transfer with forced flow, mass transport through interface
Chemical Engineering II/Separation Engineering	9	continuous distillation, pressure drop and gas absorption in packed bed tower, cyclone characteristics for particle sizes
Chemical Engineering II/Reaction Engineering and Process Control	9	gas-solid reaction, gas-solid catalytic reaction, , dynamic characteristics in process control

【Textbook】Textbook edited by teaching staff in department of chemical engineering

【Textbook(supplemental)】Bird, Stewart, Lightfoot, Transport Phenomena, 2nd Ed. (Wiley)
Hashimoto and Ogino, Gendai Kagaku Kogaku (Sangyo Tosyo)
Hashimoto, Hanno Kogaku (Baifukan)
Smith, Van Ness, Abbott, Introduction to Chemical Engineering Thermodynamics, 7th Ed.(McGraw Hill)

【Prerequisite(s)】Physical Chemistry I, II (Chemical Engineering), Fundamental Fluid Mechanics, Transport Phenomena, Chemical Reaction Engineering I, II, Fluid Phase Separation Engineering, Fine Particle Technology, Process Control are recommend to take in advance.

【】

【Web Sites】

【Additional Information】

73070

Chemical Reaction Engineering II

反応工学 II

【Code】73070 【Course Year】3rd year 【Term】1st semester 【Class day & Period】Monday 【Location】W201

【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture and practice 【Language】Japanese

【Instructor】Prof. Motoaki Kawase, Associate Prof. Hiroyuki Nakagawa, Junior Associate Prof. Ryuichi Ashida

【Course Description】Kinetic analysis and reactor design of heterogeneous chemical reactions and nonideal flow reactors are described.

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Homogeneous and heterogeneous reactions	1	
Complicated reaction rate equations	1	
Macromixing and micromixing in nonideal flow	3	
Gas-solid reactions and reactors	3.5	
Solid-catalyst reactions and reactors	3.5	
Gas-liquid and gas-liquid-solid-catalyst reactions and reactors	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

73080

Solid-Phase Separation Engineering

固相系分離工学

【Code】73080 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2
【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese
【Instructor】Noriaki Sano, Satoshi Watanabe
【Course Description】To understand various separation opertions used in industrial chemical processes, multiphase transport phenomena, transport properties, methods to design separation operations will be lectured. Expecially, drying, adsorption, menbrane separation and crystallization will be taken as practical examples.
【Grading】Evaluation will be made based on midterm exam, routine exam at the end of semester, and reports often given in lectures.
【Course Goals】The present course aims at achieving the following three goals by taking some types of solid-phase separation operations for example: (1) understanding mass balance, heat balance, and simultaneous transport phenomena of mass and heat, (2) cultivating the ability to design and develop separation units and materials used for multi-phase separations, and (3) developing knowledge on recent trends of separation techniques.
【Course Topics】

Theme	Class number of times	Description
Adsorption Operations	4	Adsorption equlibrium as dynamic equilibrium, adsorption isotherm, diffusion in pores and at surface, adsorption rate, and so forth will be explained. In addition, how to disign adsorption operation and how to calculate breakthrough curve in fixed bed type adsorbing column will be lectured.
Humidification Operations	1	Humidication operation will be lectured as example of simultaneous transport of heat and mass at gas-liquid interface. The students will understand the idea of wet-bulb temperature and how to use humidity chart.
Drying Operations	4	The mechanisms and kinetics of drying and expertise to select and desing of tne dyring unit type will be lectured, relating operation condistions with properties of the dried products.
Membrane Separation Operations	3	With the main focus on the gas separation, permeability equations and process designs of membrane separation processes will be lectured.
Crystallization Operations	2	The mechanism of the crystallization and kinetic analysis of the crystal growth will be lectured, followed by the explanation on the population balance required for the design of apparatuses. Finally, students’ understanding on the course will be tested.
Feedback class	1	A supplementary lecture or exercise class will be conducted as an additional class to give advanced knowledge or to confirm the attainment level of the course goals.

【Textbook】"Gendai Kagaku Kogaku," K. Hashimoto and F. Ogino (Sangyo Tosho)
"Kanso Gijutu Jitsumu Nyumon," H. Tamon (Nikkan Kogyo Shinbun)
【Textbook(supplemental)】"Kagakukikai no Riron to Keisan," S. Kamei (Sangyo Tosho)
【Prerequisite(s)】Introduction to Industrial Chemistry (Material and energy balances),
Fundamentals of Chemical Process Engineering,
Fluid-Phase Separation Engineering
【】
【Web Sites】
【Additional Information】Lecture will be given basen on the textbook. Exercise problems will be given to students to deepen understanding in due course.

Fine Particle Technology

微粒子工学

【Code】70700 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Matsusaka, Miyahara,

【Course Description】Powders and particles are widely used in chemical manufacturing processes as raw materials and industrial products. Fundamental properties of particles and powder beds, behavior of dispersed particles in gases and liquids, and operation methods for nucleation, separation, collection,and so on are lectured.

【Grading】Examination and reports

【Course Goals】Understand the fundamental properties of particles and powder beds, and analysis method of particle behavior. Furthermore develop the ability to apply the knowledge for particle operations such as nucleation, separation, collection,and so on.

【Course Topics】

Theme	Class number of times	Description
Introduction	1	
Fundamental properties of particles	4	
Particle system in gases	5	
Particle system in liquids	4	
Summarizing	1	

【Textbook】K. Okuyama, H. Masuda and S. Morooka: Biryuushi Kougaku － Fine particle technology, Ohmsha, Tokyo (1992)

【Textbook(supplemental)】

【Prerequisite(s)】

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【Web Sites】

【Additional Information】

70710

Process Systems Engineering

プロセスシステム工学

【Code】70710 【Course Year】3rd year 【Term】2018・2nd semester 【Class day & Period】Thursday・2nd Period 【Location】W301
【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese
【Instructor】Graduate School of Engineering, Professor Shinji Hasebe, Assistant Professor, Osamu Tonomura
【Course Description】The chemical processes consist of various unit operations. In this course, the concepts and the methods of optimal synthesis,optimal design and production management are described. The mathematical methods for optimization are also explained.
【Grading】Homework assigned in the lectures is treated as 30 points, and the final examination is treated as 70 points of the total score.
【Course Goals】This course aims to understand the systematic modelling procedures of the design and operational problems for chemical processes. In addition, it is requested to understand the optimization methods for solving the problems which are formulated as the linear, non-linear or combinatorial programming problem.
【Course Topics】

Theme	Class number of times	Description
What is PSE?	1	The concept of process systems engineering is explained.
Modelling of the processes -physical model	1	The feature of physical models used in the process design and operation problems is explained.
Modelling of the processes - statistical model	1	The least square method used in constructing the statistical model is explained.
Procedure of process design	1	The procedure of process design and the solution method using input and output model are explained.
Process design using simulation	1	The sequential modular approach which is commonly used in the process simulators is explained.
Process synthesis	1	The combinatorial programming method and multi-step heuristic method which are used in the conceptual design are explained.
Heat exchanger network synthesis	2	A systematic synthesis method using T-Q diagram is explained for the heat exchanger network synthesis problem.
Production management of chemical processes	1	The concept of production management including supply chain problem is explained.
Solution procedure using LP	2	The formulation of the production planning problem as a linear programming problem, and its solution method using the simplex method are explained.
Scheduling problem and B&B method	2	The formulation of the scheduling problem of batch processes as a traveling salesman problem and its solution procedure using the branch and bound method are explained.
Various scheduling problems of batch processes	1	Various scheduling problems which arise in batch processes and their solution methods are explained.
Evaluation of learning achievement	1	The comprehensive review is executed, and the misunderstanding of the homework is explained.

【Textbook】Lecture materials are distributed in the class.
【Textbook(supplemental)】
【Prerequisite(s)】The basic knowledge of chemical engineering such as the unit operation and reaction engineering, and that of differential and integral calculus are requested.
【】
【Web Sites】
【Additional Information】

71010

Simulations in Chemical Engineering

化学工学シミュレーション

【Code】71010 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Ryoichi Yamamoto, Hideki Tanaka

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	1	
	2	
	1	
	2	
	1	
	4	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

73090

Physical Chemistry III (Chemical Enginnering)

物理化学 III（化学工学）

【Code】73090 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Graduate School of Engineering, Professor Minoru Miyahara

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	1	
	1	
	1.5	
	1.5	
	2	
	1	
	1	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

73150

Scientific English (Chemical Enginnering)

科学英語（化学工学）

【Code】73150 【Course Year】3rd year 【Term】2018・2nd semester 【Class day & Period】Monday・3rd Period or 4th Period 【Location】W301 【Credits】2 【Restriction】3rd year students of the Undergraduate Course Program of Chemical Process Engineering 【Lecture Form(s)】Lecture 【Language】English 【Instructor】Shuji MATSUSAKA, John Pryce

【Course Description】This course aims to give students an opportunity to use and expand on their current English skills in a Scientific context, specifically within the field of Chemical Engineering. In addition, since all instruction is in English, the course focuses on creating an environment where students can develop their overall skills in International Communication in both oral and written formats.

【Grading】Assessment 1 (week 12) - 20% Assessment 2 (week 15) - 20% Final Written exam - 60%

【Course Goals】The goals of this course are: 1. To enable students to become conversant in English within various aspects of Chemical Engineering. 2. To improve and expand student's specialized vocabulary and pronunciation skills. 3. To give students confidence in oral and written communication skills regarding technical data, unit operations, process design and technical descriptions in English. 4. To develop student's overall ability in speaking, listening, reading and writing, as well as, critical thinking skills with regards to Chemical Engineering topics. 5. To develop and contribute to the student's confidence and knowledge to be able to attend international conferences, conduct presentations and publish papers in English.

【Course Topics】

Theme	Class number of times	Description
Unit 1-15		The course is divided into 15 classes over 15 weeks and the topics have been selected and sequenced to take the students through key aspects of Chemical Engineering beginning with elementary specialized vocabulary and pronunciation, culminating in technical trouble shooting and presentation of a solution.
Unit 1 Chemistry/Chemical Engineering - periodic table, organic and inorganic chemistry nomenclature	1	The student will be able to correctly pronounce and be aware of the differences in terminology between Japanese and English chemistry nomenclature.
Unit 2 Mathematical Sciences	1	The student will be able to clearly explain mathematical operations, calculations and results obtained by experiment.
Unit 3 Units of Measurement/Explaining process equipment dimensions (piping, valves, instrumentation, pumps, vessels and various process equipment)	1	The student will be able to express units of measurement and Conversions, explain physical dimensions and process equipment features.
Unit 4-11 Unit Operations - Fluid Transportation, Heat Transfer, Mass Transfer, Thermodynamic Processes and Mechanical Processes	8	The student will be able to describe various unit operations in English and describe how they integrate with different processes. Focusing on specific vocabulary, phrasal verbs and order of adjectives in describing.
Unit 12 Oral Assessment - Presentation of a unit operation	1	The student will be able to present, describe and explain the application to a process for a unit operation of their choice.
Unit 13 Process and Instrumentation Diagrams incorporating unit operations	1	The student will be able to read and explain process instrumentation diagrams in English.
Unit 14 Plant Start-up and Shut-down/operating instructions	1	The student will be able to provide and describe sequencing instructions for plant operations.
Unit 15 Oral Assessment - Troubleshooting and explaining solutions	1	The student will be able use critical thinking skills to troubleshoot a Process and instrumentation diagram and explain their solution.

【Textbook】Handouts will be given each lesson.

【Textbook(supplemental)】Nothing specified.

【Prerequisite(s)】Students enrolled in the Chemical Process Engineering Course of the School of Industrial Chemistry.

【】All instruction will be in English, so students are advised to work on improving listening skills both before and during the course.

【Web Sites】Nothing specified.

【Additional Information】Nothing specified.

70720

Process Design

プロセス設計

【Code】70720 【Course Year】4th year 【Term】2018・1st semester 【Class day & Period】Friday・3rd Period

【Location】304 Katsura A2 Bldg 【Credits】2 【Restriction】Restriction 【Lecture Form(s)】Lecture and Exercise

【Language】Japanese

【Instructor】Graduate School of Engineering, Professor Shinji Hasebe, Daicel Corp. Kazuyoshi Baba, and all faculty members in the Chemical Engineering Department

【Course Description】The fundamental skills of designing chemical processes which consist of various unit operations are learned. Then, a conceptual design exercise of a chemical process is executed using the knowledge of chemical engineering and process simulation system.

【Grading】The results are evaluated by the contents of the final report and the oral presentation.

【Course Goals】It is requested to understand the way of conceptual design, and to have the skill of designing chemical processes by applying the knowledge of chemical engineering and related field.

【Course Topics】

Theme	Class number of times	Description
Concept of process design	1	The concept of process design and the procedure of conceptual design are explained.
Evaluation methods	1	After explaining the fundamental terms on economical efficiency evaluation, a single-year evaluation method and a multi-year evaluation method are explained.
How to use process simulators	1	The sequential modular approach that is commonly used in the process simulators is explained. Then, how to use process simulator is explained using the demonstration.
Reality of process design	6	According to the procedure of process design, some important points and available methods on market research, acquisition of data, process synthesis and equipment design are explained. (Intensive course)
Practice of a chemical process design	17	The exercise on process design is performed by group consisting of 2 or 3 students.
Oral presentation	4	The final design of each group is presented at the workshop where all members of the faculty attend.

【Textbook】The reference materials are prepared by teachers.

【Textbook(supplemental)】

【Prerequisite(s)】The basic knowledge on chemical engineering such as unit operation is requested.

【】

【Web Sites】http://www.cheme.kyoto-u.ac.jp/processdesign/

【Additional Information】Since the exercise is supervised by faculty members in each laboratory, the registration is restricted to senior students belonging to Chemical Process Engineering Course.

74000

Chemical Process Engineering

化学プロセス工学

【Code】74000 【Course Year】2nd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】S. Hasebe, S. Matsusaka, N. Sano, S. Watanabe, T. Maki

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	2	
	3	
	2	
	2	
	3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

70280

Industrial Organic Chemistry

有機工業化学

【Code】70280 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Ohe, Tanaka, Mae, Tuji, Atomi, Kawase,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2	
	2	
	3	
	2	
	1	
	2	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

Biochemical Engineering

生物化学工学

【Code】70300 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Haruyuki Atomi, Itaru Hamachi, Masato Umeda, Shigeki Kiyonaka, Masayuki Mori, Yuji Hara, Tamotsu Kanai

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	4	
	3	
	3	
	4	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

70420

Introduction to Environmental Preservation

環境保全概論

【Code】70420 【Course Year】3rd year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Shinichi Sakai, Hiroyuki Nakagawa, Satoshi Hashimoto

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	3	
	2	
	5	
	2	
	2	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

70430

Chemistry and Environmental Safety

環境安全化学

【Code】70430 【Course Year】3rd year 【Term】【Class day & Period】【Location】【Credits】2 【Restriction】

【Lecture Form(s)】Lecture 【Language】Japanese 【Instructor】Ryu Abe, Hiroyuki Nakagawa, Satoshi Hashimoto

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	2-3	
	2-3	
	2-3	
	2-3	
	2-3	
	2-3	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

70560

Electrochemistry

電気化学

【Code】70560 【Course Year】4th year 【Term】 【Class day & Period】 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Takeshi Abe, and Tomokazu Fukutsuka, and Kouhei Miyazaki

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
Fundamental of electrochemical reaction	4	
Kinetics of electrochemical reaction	4	
Battery and fuel cell	4	
Electrolysis	1	
Corrosion	1	
Evaluation	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

70590

Spectroscopy for Organic Compounds

有機分光学

【Code】70590 【Course Year】4th year 【Term】 【Class day & Period】Tue 3rd 【Location】 【Credits】2

【Restriction】No Restriction 【Lecture Form(s)】 【Language】Japanese

【Instructor】Masahiro Murakami, Takuya Kurahashi, Hikaru Takaya, Kazuo Tanaka

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2	
	2	
	1	
	8	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

70960

Safety in Chemistry Laboratory

化学実験の安全指針

【Code】70960 【Course Year】4th year 【Term】【Class day & Period】【Location】【Credits】1 【Restriction】

【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Hiroyuki Nakagawa, Ryu Abe, Masatoshi Tosaka, Masashi Ohmae, Aiichiro Nagaki, Kenji Sugase

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	1	
	1	
	1	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

21050

Engineering Ethics
工学倫理

【Code】21050 【Course Year】4th year 【Term】2018 first semester 【Class day & Period】Thu 3rd 【Location】Research Bldg. No.8, 3F, NS Hall 【Credits】2 【Restriction】No Restriction 【Lecture Form(s)】Lecture 【Language】Japanese

【Instructor】Dean of the Faculty of Engineering
Graduate School of Engineering, Professor, Makoto OHSAKI
Graduate School of Energy Science, Professor, Hirohiko TAKUDA
Graduate School of Engineering, Junior Associate Professor, Ryosuke MATSUMOTO

【Course Description】Modern ethics based on engineering aspect are becoming essential to present engineers and scientists. Instructors from various faculties give lectures about ethics in their research fields.

【Grading】Class participation and reports.

【Course Goals】The goal of this class is to understand engineering ethics, and to develop the ability to judge by yourself when you encounter ethical issues.

【Course Topics】

Theme	Class number of times	Description
Significance to learn engineering ethics(4/12)	1	This class gives students explanation about what engineering ethics is and the reason why it is necessary to learn it introducing some troubles in the field of transportation engineering and planning. (N. Uno: Global Engineering)
Ethics in information society on the view point of information technology(4/19)	1	Information devices such as PCs and smartphones and various web services such as SNS are very convenient, but there are also risks of being dangerous depending on usage. In this lecture, we describe the knowledge and the code of conduct to live safely in the information society. (A. Yamamoto: Informatics and Mathematical Science)
(4/26)	1	(M. Mizutani: Graduate School of Letters)
Ethical theories for engineering ethics (5/10)	1	This lecture will focus on basic ethical theories such as utilitarianism, deontology and virtue ethics which will be useful for thinking about particular ethical problems in engineering ethics. (S. Kodama: Graduate School of Letters)
Ethics in Architectural Engineering(5/17)	1	Discussions will be held to increase the ability as engineers to responsibly confront moral issues in the field of building engineering using actual technological activities as examples, such as putting water into fresh concrete, falsification of earthquake-resistance data, shoddy workmanship and architect qualification fraud. (M. Nishiyama: Architecture)
Engineering ethics in operation and maintenance of structures(5/24)	1	Although operation and maintenance of structures such as a plant and an aircraft require enormous labor and cost, unsuitable operation and maintenance may lead to serious accidents that cause unmeasurable damage. This class discusses engineering ethics that engineers are required under the situation. (T. Hayashi: Engineering Science)
Research and engineering ethics(5/31)	1	It is said that He that will do no ill, must do nothing that belongs thereto. The sense of ethics necessary to whom conducts research and engineering work in society is discussed in terms of the importance of equitability and fair evaluation to anyone involved in each area of research or engineering. (H. Mikada: Global Engineering)
Patents and Ethics (Part 1)(6/7)	1	This course will teach the students about 1) patent systems which protect inventions and research results and 2) ethical issues in patents. The first class, in preparation for the next subject of patent ethics, introduces Japan ’ s patent system with comparisons to the patent systems in the world ’ s major countries and international framework. (M. Nakagawa: Electrical and Electronics Engineering)
Patents and Ethics (Part 2) (6/14)	1	Students, equipped with the basic knowledge of patent systems by the previous lecture, will get familiar with actual case studies on ethical and legal issues in patents. (M. Nakagawa: Electrical and Electronics Engineering)
Ethics Required for Advanced Science(6/21)	1	Engineers and researchers are at the forefront of preventing harm caused by advanced chemistry. Think about social roles and ethics required by engineers and researchers through relationships between chemical substances and environmental problems, efforts to avoid hazards of nanomaterials. (K. Miura: Industrial Chemistry)
Ethics in nuclear engineering(6/28)	1	Nuclear technology can brew up an expansive and long-running catastrophe as well as it brings significant value of stable electricity in normal times. Some examples of ethics in nuclear engineering are introduced and important issues are talked. (I. Takagi: Engineering Science)
Ethics in biomedical engineering(7/5)	1	Recent dramatic progress in biology-related techniques, such as reproductive medicine, genome editing, and clone-animal techniques, is causing revolutions in the fields of medicines and food productions. Associated with it, problems of their safety and ethics are arising, which should be addressed by our societies. In this class, the recent progress in biology-related techniques, and problems we have and will have in near future are described. (M. Shirakawa: Industrial Chemistry)
Ethics of biotechnology and stem cell research(7/12)	1	With the rapid development of genome editing technology and stem cell engineering, editing of the human genome that goes beyond generations has become possible, at least technically. In this lecture, I will introduce these latest technologies and think about ethical problems accompanying technological development. (G. Eiraku: Industrial Chemistry)
Art-view Concept for Engineering(7/19)	1	Concept of "quality of life" is required for human related engineering. Some practical examples in medical-care and welfare fields will be introduced, and problem of the QOL-evaluation will be discussed from both function-optimizing view point and art view point. (N. Tomita: Engineering Science)
Ethics for Civil Engineers (7/26)	1	Civil Engineers play a key role on development of social infrastructures to protect people's lives from natural disasters and to support social and economic activities. This lecture introduces the engineering ethics on development of social infrastructures with specific examples. (T. Yagi: Global Engineering)

【Textbook】Lecture materials will be distributed.

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】The class order is subject to change.

21080

Introduction to Engineering

工学序論

【Code】21080 【Course Year】1st year 【Term】 【Class day & Period】 【Location】 【Credits】1

【Restriction】No Restriction 【Lecture Form(s)】 【Language】 【Instructor】,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1~2	
	6	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

22210

Engineering and Economy(in English)

工学と経済（英語）

【Code】22210 【Course Year】2nd year and above 【Term】2018 first semester 【Class day & Period】Tuesdays 5th-6th

【Location】工学部総合校舎１１１講義室 【Credits】2 【Restriction】【Lecture Form(s)】【Language】English 【Instructor】Juha Lintuluoto

【Course Description】The purpose of this course is to teach economy from an engineer viewpoint. The course especially contains such economic topics which engineer can use to solve practical engineering economy problems. The course is consisted of lectures and additional exercises, of which the student should complete five (5) written short reports and five (5) 60 minutes laboratory session attendances. The laboratory sessions are held weekly after the lecture, and consist of interactive group work tasks. Laboratory sessions are held weekly from 18 to 19 o’clock.// The course is aimed for both Japanese and Foreign nationals.// The course starts on April 10th.

【Grading】Test, reports, laboratory performance.

【Course Goals】This course will provide tasks for engineering students to be able to understand relationships between engineering and engineering economy. Students will learn solving economic problems related to engineering project at various levels. The course also prepares the students to write engineering related economic topics in English as well as verbally express themselves of these subjects.

【Course Topics】

Theme	Class number of times	Description
Student orientation, Introduction to engineering economy	1	Course introduction; Principles of engineering economy
Cost concept	1	Cost terminology; Competition; Total revenue function; Breakeven point
Design economics	1	Cost-driven design; Making vs. purchasing; Trade-offs
Cost estimation techniques I	1	Integrated approach and WBS; Index, unit, and factor techniques
Cost estimation techniques II	1	Parametric estimating; Power-sizing technique; Learning curve; Cost estimation, bottom-up, top-down, target costing
The time value of money I	1	Simple interest; Compound interest; Equivalence concept;Cash-flow digrams
The time value of money II	1	Present and future equivalent values of single cash flows
The time value of money III	1	Uniform series cash flows; Deferred annuities; Uniform gradient cash flows; Nominal and effective interest rates
Evaluation of a single project I	1	Determining minimum attractive rate of return (MARR); The present worth method; Bond value; Capitalized-worth method
Evaluation of a single project II	1	The future worth method; The annual worth method; The internal rate of return method; The external rate of return method
Comparison and selection among alternatives I	1	Basic concepts; The study (analysis) period; Useful lives are equal to the study period
Comparison and selection among alternatives II	1	Useful lives are unequal to the study period; Repeatability; Cotermination; The imputed market value technique
Income taxes and depreciation	1	Concepts and terminology; Depreciation; Straight-line method; Declining-balance method; Income taxes; Marginal tax; Gain or loss on the disposal of an asset; After-tax economic analysis
Final test	1	The test is based on the above topics

【Textbook】Sullivan, Wicks, Koelling; Engineering Economy, 15th Ed. 2012 , Chapters 1-7.

【Textbook(supplemental)】

【Prerequisite(s)】Note:

-Interactive lessons (discussion), Small group working method

-This course is held in English.

【】

【Web Sites】None

【Additional Information】If you have any questions or need further information, feel free to contact at 090aglobal@mail2.adm.kyoto-u.ac.jp.

24010

Global Leadership Seminar I

ＧＬセミナーⅠ（企業調査研究）

【Code】24010 【Course Year】 【Term】 【Class day & Period】 【Location】 【Credits】1 【Restriction】

【Lecture Form(s)】 【Language】Japanese 【Instructor】,

【Course Description】

【Grading】

【Course Goals】

【Course Topics】

Theme	Class number of times	Description
	1	
	2~3	
	2~3	
	12	
	3~4	
	1	
	1	

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】

【】

【Web Sites】

【Additional Information】

25010

Global Leadership Seminar II

ＧＬセミナーⅡ（課題解決演習）

【Code】25010 【Course Year】2nd year or higher 【Term】FY2018, 2nd semester, intensive
【Class day & Period】Intensive course 【Location】Announced elsewhere 【Credits】1
【Restriction】Restricion in number to around 20 selected students 【Lecture Form(s)】Lecture and excercise
【Language】
【Instructor】Faculty of Engineering, J. Assoc. Prof., Yoshinori Tanaka
Faculty of Engineering, J. Assoc. Prof., Ryuichi Ashida
Faculty of Engineering, J. Assoc. Prof., Aiko Takatori
Faculty of Engineering, J. Assoc. Prof., Tadao Mizuno
Faculty of Engineering, J. Assoc. Prof., Ryosuke Matsumoto
Related professors
【Course Description】This course is a small-group workshop program where students are supposed to extract or set up challenges by themselves aiming at creating new social values. In concrete, abilities of planning and problem-solving are trained through group works in residential training and skills of presentation and communication are enhanced through oral presentations regarding contents of the proposal at each step of the process from a preliminary draft to its completion.
【Grading】It is required to join the residential training. A report meeting is held and comprehensive evaluation concerning abilities in group discussion to extract or set up challenges and to propose solutions for achieving a goal is made through presentation of the proposal as well as a submitted report.
【Course Goals】Ability of planning, from extraction or setting up challenges to proposal of solutions aiming at creating new social values, is trained through group works.
【Course Topics】

Theme	Class number of times	Description
Orientation	1	A brief overview and a schedule of the course are explained and working groups are organized.
Lectures	2	Lectures by experts are given.
Group works	3	Setting up challenges, extraction of problems, collecting information, and group works are done.
Residential training	7	Through intensive group works based on discussion, a proposal for solving problems is planned, a draft report is made, and a few presentations are made.
Preliminary review meeting	1	A preliminary review meeting is held and discussions are made.
Report meeting	1	Final presentations are made and reports are submitted.

【Textbook】Will be indicated as necessary.
【Textbook(supplemental)】Will be indicated as necessary.
【Prerequisite(s)】
【】
【Web Sites】
【Additional Information】Course open period: October to January
How to register the course will be instructed.
*It depends on divisions which students belong to whether the earned credits are admitted as credits required for graduation. Please refer to the syllabus of your division.

24020

International Internship of Faculty of Engineering I

工学部国際インターンシップ１

【Code】24020 【Course Year】Junior and Senior students 【Term】Through the academic year

【Class day & Period】Intensive course 【Location】Defined in each internship program. 【Credits】1

【Restriction】Defined in each internship program 【Lecture Form(s)】Exercise 【Language】English, et al.

【Instructor】Chairperson of Foreign Students and International Academic Exchange Subcommittee, Faculty members in charge of educational affairs of the undergraduate school the registrant belongs to.

【Course Description】Acquisition of international skills with the training of foreign language through the internship programs hosted by the University, the Faculty of Engineering, or the undergraduate school the applicant belongs to.

【Grading】Marit rating is done based on the presentation or reports after each internship program. Each Ｄepartment responsible to identify if the credit earned by this subject to be included as mandatory ones or not. If the credit is not included in the undergraduate school in which the participant belongs to, the credit is granted by the Global Leadership Education Center as a optional credit. The number of credits, either 1 or 2, will be determined depending on the contents and the duration of the program that the participant has participated in.

【Course Goals】The acquisition of international skills with the training of foreign language through the to internship programs hosted by the University is the major expectation to the students.

【Course Topics】

Theme	Class number of times	Description
Overseas Internship	1	The contents to be acquired should be described in the brochure of each internship program.
Final Presentation	1	A presentation by the student is required followed by discussion among participants.

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】Described in the application booklet for each internship program. The registrant is requested to have enough language skills for the participation.

【】

【Web Sites】

【Additional Information】It is required for students to check if the internship program to participate in could be evaluated as part of mandatory credits or not and could earn how many credits before the participation to the undergraduate school or educational program the student in enrolled. If the credit could not be treated as mandatory ones, get in touch with the Global Leadership Engineering Education Center.

International Internship of Faculty of Engineering 2

工学部国際インターンシップ２

【Code】25020 【Course Year】Junior and Senior students 【Term】Through the academic year

【Class day & Period】Intensive Course 【Location】Defined in each internship program. 【Credits】2

【Restriction】Defined in each internship program. 【Lecture Form(s)】Exercise 【Language】English, et al.

【Instructor】Chair of Foreign Students and International Academic Exchange Subcommittee, Faculty members of the Undergraduate School the registrant belongs to.

【Course Description】Acqusition of international skills with wth the training of foreign language through the participation to the international internship programs held by the Faculty of Engineering or its subsidiary bodies.

【Grading】Marit rating is done based on the presentation or reports after each internship program. Each Department responsible to identify if the credit earned by this subject to be included as mandatory ones or not. If the credit is not included in the undergraduate school in which the participant belongs to, the credit is granted by the Global Leadership Education Center as a optional credit. The number of credits, either 1 or 2, will be determined depending on the contents and the duration of the program that the participant has participated in.

【Course Goals】The acquisition of international and foreign language skills through the participation to international programs is expected. Detailed objectives of the participation should be identified by each program.

【Course Topics】

Theme	Class number of times	Description
Overseas Internship	1	The contents to be acquired should be described in the brochure of each internship program.
Final Presentation	1	A presentation by the student is required followed by discussion among participants.

【Textbook】

【Textbook(supplemental)】

【Prerequisite(s)】Described in the application booklet for each internship program. The registrant is requested to have enough language skills for the participation.

【】

【Web Sites】

【Additional Information】It is required for students to check if the internship program to participate in could be evaluated as part of mandatory credits or not and could earn how many credits before the participation to the undergraduate school or educational program the student in enrolled. If the credit could not be treated as mandatory ones, get in touch with the Global Leadership Engineering Education Center.

工学部シラバス 2018 年度版
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デザイン　工学研究科附属情報センター

工学部シラバス 2018 年度版

・ Common Subjects of Faculty of Engineering
・[A] Global Engineering
・[B] Architecture
・[C] Engineering Science
・[D] Electrical and Electronic Engineering
・[E] Informatics and Mathematical Science
・[F] Industrial Chemistry
・**オンライン版**　http://www.t.kyoto-u.ac.jp/syllabus-s/

本文中の下線はリンクを示しています．リンク先はオンライン版を参照してください．

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