[Title]			[Instructor]		
Advanced Organic Chemistry			Tetsuo Kuwabara		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA501	2	Applied Chemistry	1st Semester	Fri.／I	English／Japanese

[Outline and purpose]

The course gives extended knowledge in the field of organic chemistry towards those who already finished to learn basic textbooks such as Jones, McMurry, Vollhardt-Schore and etc. This course mainly describes the fundamentals of organic chemistry involving syntheses, reactions, structural and physical organic chemistry, bio-organic chemistry and supramolecular chemistry. In addition, some of recently advanced subjects in the related fields are introduced.

[Objectives]

We will learn about fundamentals of organic chemistry involving syntheses, reactions, structural and physical organic chemistry, bio-organic chemistry and supramolecular chemistry

[Requirements]

Completion of undergraduate course covering basic organic chemistry.

[Evaluation]

Participation in class 20%
Term paper to be submitted at the end of the course 80%

[Textbooks]

Not specified

[References]

Not specified

[Schedule]

1. Guidance: biomimetic chemistry
2. Intermolecular interactions
3. Molecular recognitions and supramolecular chemistry
4. Precursor and preparation of supramolecules
5. Preparation of self-assemblies
6. Preparation of molecular assemblies
7. Synthesis and functions of rotaxanes
8. Synthesis and functions of catenanes
9. Synthesis and functions of dendrimers
10. Synthesis and functions of molecular machines
11. Nanostructure
12. Nanosensing
13. Application of Nanostructure
14. Future of nanomaterials
15. Summary and comprehensive evaluation

[Title]			[Instructor]		
Advanced Inorganic Chemistry I			Hideto Sakane/ Naoya Miyajima		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA502	2	Applied Chemistry	1st Semester	Mon. / II	English /Japanese

[Outline and purpose]

This program is a lecture on basic and structural characteristics, theory, nomenclature, and spectroscopic properties of metal complexes, in which molecules and ions coordinate to central metal ion(s). Students also learn the basic and application of surface/interface science of materials. They can deeply understand the field of surface adsorption technology for evaluating the surface/pore of materials such as carbons.

[Objectives]

Students are expected to be able to account the structure, bonding, and spectrochemical properties of transition metal complexes and to name inorganic compounds. Students are also expected to be able to explain the fundamental principle and application of solid-surface modification and its evaluation.

[Requirements]

Expertise of general inorganic, physical, and quantum chemistry.
Basic knowledge of physical chemistry and electrochemistry.

[Evaluation]

Homework/Reports 90% (Reports on the questions given in several hours.)
Class participation 10%

[Textbooks]

1. 日本化学会 命名法専門委員会 編, 化合物命名法 － IUPAC 勧告に準拠 － 第 2 版, 東京化学同人, ISBN:9784807908882 (in Japanese).
2. 平尾 一之、田中 勝久、中平 敦, 無機化学 その現代的アプローチ 第 2 版, 東京化学同人, ISBN: 9784807908240 (in Japanese).

[References]

1. 三吉 克彦, 金属錯体の構造と性質, 岩波書店, ISBN: 9784000110426 (in Japanese).
2. 上村 洸、菅野 暁、田辺 行人, 配位子場理論とその応用, 裳華房, ISBN: 9784785324049 (in Japanese).
3. 近藤 精一, 石川 達雄, 安倍 郁夫, 吸着の科学, 丸善, ISBN:461048430 (in Japanese).
4. 炭素材料学会編, 新・炭素材料入門, リアライズ, ISBN:4947655925 (in Japanese).

[Schedule]

1. Coordination bond and complex
2. Representative structures of complex and their isomerism
3. Interpretations of electronic states by valence bond theory
4. Crystal and ligand field theories
5. Structure of complex
6. Stability and reaction of complex
7. Nomenclature of inorganic compounds
8. Surface and interface
9. Surface modification and surface/pore control
10. Fundamental study of adsorption theory
11. Fundamental study of adsorption measurement method
12. Applications of surface modification and adsorption theory
13. Applications of adsorption measurement method
14. Adsorption and separation technology
15. Summative assessment for total score

[Title]			[Instructor]		
Advanced Inorganic Chemistry II			Satoshi Wada / Hiroshi Yanagi/Katsuyoshi Kakinuma		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA503	2	Applied Chemistry	2nd Semester	Thu.／I	English／Japanese

[Outline and purpose]

Students learn the basics and application of electron behavior in solids

[Objectives]

To understand fundamental principle of electronic and optical properties of solids

[Requirements]

A good grounding in Physical Chemistry, Inorganic Chemistry, and Quantum Chemistry.

[Evaluation]

1 Midterm examination　30%
2 homework　30%
3 class participation　40%

[Textbooks]

[References]

[Schedule]

*The lectures from 1 to 5 are held with Zoom or Teams.
*The lectures from 6 to 10 are held on demand.
*The lectures from 10 to 15 are held with Zoom.

1. Introduction
2. Crystal Structure
3. Chemical bonding and band structure
4. Spectroscopic methods
5. Material design based on electronic structure
6. The essence of electronic structure
7. Material design based on electronic structure
8. Mechanism of electric polarization
9. Complex dielectric constant and dielectric relaxation
10. Evaluation of dielectric properties
11. Electrical conductivity
12. Defect and nonstoichiometry in solid
13. Mechanism of electronic conductivity
14. Mechanism of ionic conductivity
15. Evaluation of electrical conductivity

[Title]			[Instructor]		
Advanced Inorganic Chemistry II			Satoshi Wada / Hiroshi Yanagi/Katsuyoshi Kakinuma		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA503	2	Applied Chemistry	2nd Semester	Thu.／I	English／Japanese

[Outline and purpose]

Students learn the basics and application of electron behavior in solids

[Objectives]

To understand fundamental principle of electronic and optical properties of solids

[Requirements]

A good grounding in Physical Chemistry, Inorganic Chemistry, and Quantum Chemistry.

[Evaluation]

1 Midterm examination　30%
2 homework　30%
3 class participation　40%

[Textbooks]

[References]

[Schedule]

*The lectures from 1 to 5 are held with Zoom or Teams.
*The lectures from 6 to 10 are held on demand.
*The lectures from 10 to 15 are held with Zoom.

1. Introduction
2. Crystal Structure
3. Chemical bonding and band structure
4. Spectroscopic methods
5. Material design based on electronic structure
6. The essence of electronic structure
7. Material design based on electronic structure
8. Mechanism of electric polarization
9. Complex dielectric constant and dielectric relaxation
10. Evaluation of dielectric properties
11. Electrical conductivity
12. Defect and nonstoichiometry in solid
13. Mechanism of electronic conductivity
14. Mechanism of ionic conductivity
15. Evaluation of electrical conductivity

[Title]			[Instructor]		
Advanced Analytical Chemistry			Junji Inukai / Toshihiro Miyao / Akiyoshi Kuzume		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA504	2	Applied Chemistry	1st Semester	Thu.／I	English / Japanese

[Outline and purpose]

The lecture covers the principles, instrumentations and applications of various analytical techniques including chromatography. By the midterm examinations and short presentations, your levels of understandings will be checked and evaluated.

[Objectives]

1. Introduction to Surface Crystallography.
2. Understanding of Adsorption Phenomena; principles and applications
3. Understanding of Chromatography; principles, instrumentations and applications

[Requirements]

Students need basic understandings (undergraduate levels) of physical, analytical and organic chemistry for attending this lecture.
Home works are given.

[Evaluation]

By reports and midterm examination: 80%
By reading an presentation: 20%

[Textbooks]

Prints

[References]

塚田捷, 表面物理入門, 東京大学出版会 (ISBN:4130621203)
近藤精一、石川達雄、安部郁夫, 吸着の科学, 丸善出版 (ISBN: 4621048430)
田中誠之、飯田芳男, 基礎化学選書７　機器分析, 裳華房 (ISBN:9784785331337)

[Schedule]

1. Introduction to surface and interface sciences: surface structure/composition, single-crystal surface
2. Basal planes and adlayer. Surface lattice
3. Reciprocal space
4. Surface structural analysis by low energy electron diffraction
5. Test on single-crystal surfaces
6. Adsorption phenomena at a gas/solid interface
7. Interpretation of adsorption isotherms
8. Adsorption on porous solids
9. Characterization for solids using adsorption phenomena
10. Chemisorption and catalytic reaction over solid surface
11. Principle and key factors of chromatographic separation
12. Retention factors in high performance liquid chromatography
13. Retention factors in gas chromatography
14. Detectors in gas chromatography, and recent gas chromatographic analysis
15. Sample preparation in gas chromatography

[Title]			[Instructor]		
Advanced Physical Chemistry			Naoki Yoneyama/ Shintaro Ueno / Ichiro Fujii		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA505	2	Applied Chemistry	2nd Semester	Tue.／I	English/ Japanese

[Outline and purpose]

We first explain the shape of molecule in view of symmetry to deepen expertise in physical chemistry, which is indispensable to research functional materials. Second, we introduce and demonstrate optical phenomena for understanding an interaction between light and matter. Last part focuses on introduction of magnetics.

[Objectives]

Students will obtain further understanding of the physical chemistry on the basis of space group. Then, students will consider the origins of various optical phenomena and optical functionalities of materials based on the fundamental theory of optics. Students can explain the terminology of magnetics, the origin of magnetism, the magnetization process of ferromagnetic materials, and the application of magnetics.

[Requirements]

All the contents concerned with physical chemistry in the undergraduate course.

[Evaluation]

Exam: 20%
Exam [intermediate]: 40%
Short test/Report: 30%
Attitude: 10%

[Textbooks]

P. Atkins and J. de Paula, Atkins' Physical Chemistry

[References]

春山志郎“表面技術者のための電気化学” (Japanese text)
日本磁気学会編、佐藤勝昭著“磁気工学超入門” (Japanese text)
谷田貝豊彦“光学” (Japanese text) / A. Lipson, S. G. Lipson, and H. Lipson, “Optical Physics”

[Schedule]

1. Guidance
2. Symmetry of molecules I: character table (Sec. 12)
3. Symmetry of molecules II: molecular vibration of water (Sec. 12, 13)
4. Symmetry of molecules III: molecular vibration of more complicated molecules (Sec. 12, 13)
5. Interim summary
6. Fundamentals of optics (characteristics and properties of electromagnetic waves)
7. Interaction between light and matter (refraction, reflection, and scattering I)
8. Interaction between light and matter (refraction, reflection, and scattering II)
9. Optical functionalities of inorganic materials (light absorption and luminescence)
10. LASER materials and applications / Interim summary
11. Application of magnetics and terminology for magnetics
12. Origin of magnetics and Weiss molecular field model
13. Magnetization process
14. Spintronics, magneto-optic effect, and magnetic resonance
15. Summary

[Title]			[Instructor]		
Advanced Polymer Chemistry			Hidenori Okuzaki / Makoto Obata		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA506	2	Applied Chemistry	2nd Semester	Thu.／II	English/Japanese

[Outline and purpose]

Polymer materials are used in aviation, space, electronics, communication, transportation, and medical care. In this lecture, you learn synthesis, characterization, and application of various functional polymers.

[Objectives]

To understand basic knowledge of synthesis, structure, and function of polymer materials.

[Requirements]

A grounding in organic chemistry, physical chemistry, and fundamental polymer chemistry.

[Evaluation]

Attendance and report: 50 %
Presentation: 50 %

[Textbooks]

[References]

[Schedule]

1. Chain polymerization 1 (radical polymerizations, copolymerizations, and kinetics)
2. Chain polymerization 2 (ionic polymerizations and ring-opening polymerizations)
3. Stepwise polymerization 1 (condensation polymerizations and kinetics)
4. Precise polymerization 1 (basics of living polymerizations and design of specific-structure polymers)
5. Precise polymerization 2 (reversible activation mechanism and controlled polymerizations)
6. Molecular weight and distributions, stereospecificity, and properties of polymers
7. Evaluation of polymer conformation by wide-angle X-ray diffraction
8. Evaluation of molecular orientation of polymer materials
9. Crystalline structure and crystallization kinetics of polymer materials
10. Dynamic viscoelastic properties of polymer materials
11. Characteristics of optical plastics
12. Optical plastics (optical lens, optical fibers, and optical disks)
13. Prescribed properties of adhesives.
14. Mechanism of adhesion (epoxy adhesives and superglues)
15. Final examination (presentation)

[Title]			[Instructor]		
Advanced Quantum Chemistry for Energy Conversion			Hiroshi Irie Toshihiro Takashima		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA507	2	Applied Chemistry	1st Semester	Thu.／II	English/ Japanese

[Outline and purpose]

This class discusses the principles of quantum mechanics first and then uses these ideas in the molecular approach to science. In every class, the attendances have a lecture, and then solve some problems to deepen their knowledge.

[Objectives]

1. To understand the basic quantum mechanics.
2. To understand the hydrogen atom, multi-electron atoms and approximation methods.
3. To understand the chemical bond: Diatomic molecules and polyatomic molecules.
4. To understand the molecular spectroscopy.

[Requirements]

Knowledge on the quantum chemistry learned in the Faculty

[Evaluation]

Attitude toward the class and practice：60%
Final examination：40%

[Textbooks]

[References]

大岩正芳：初等量子化学 第 2 版、化学同人、2006 年（in Japanese）

[Schedule]

1. The dawn of the quantum chemistry
2. The classical wave function
3. The Schrodinger equation and a particle in a box
4. Some postulates and general principles of quantum mechanics
5. The harmonic oscillator and the rigid rotator
6. The hydrogen atom
7. Approximation methods 1
8. Approximation methods 2
9. Multi-electron atoms
10. The chemical bond: Diatomic molecules
11. Bonding in polyatomic molecules
12. Electronic states of π-conjugated molecule
13. Group theory: The exploitation of symmetry
14. Molecular spectroscopy
15. Final examination

[Title]			[Instructor]		
Advanced Course of Materials Design for Fuel Cells			Hiroyuki Uchida / Kenji Miyatake / Shinji Nohara		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA508	2	Applied Chemistry	2nd Semester	Tue.／II	English／Japanese

[Outline and purpose]

Fuel cells are electric power supply devices, which convert chemical energy to electric energy directly and reciprocally. Among them, polymer electrolyte fuel cells (PEFCs) for electric vehicles, portable devices, and residential power supply and solid oxide fuel cells (SOFCs) as on-site power generation have attracted a considerable attention. In this class, principle, design and evaluation of these fuel cells and their component materials will be discussed.

[Objectives]

To understand principle and evaluation of PEFCs and SOFCs and their component materials

[Requirements]

Basic knowledge on electrochemistry and physical chemistry

[Evaluation]

Report and examination: 50%
Mark given for class participation: 50%

[Textbooks]

None

[References]

Denkikagakugairon (co-authored by Matsuda and Iwakura), Maruzen, ISBN: 4621039962

[Schedule]

1. Electrochemistry of fuel cells 1
2. Electrochemistry of fuel cells 2
3. Principle and research trend of fuel cells 1
4. Principle and research trend of fuel cells 2
5. Design of fuel cell electrocatalysts: cathode catalysts 1
6. Design of fuel cell electrocatalysts: cathode catalysts 2
7. Design of fuel cell electrocatalysts: anode catalysts 1
8. Design of fuel cell electrocatalysts: anode catalysts 2
9. Methanol oxidation catalysts 1
10. Methanol oxidation catalysts 2
11. Design of highly dispersed catalysts 1
12. Design of highly dispersed catalysts 2
13. Design of functional materials 1
14. Design of functional materials 2
15. Summary

[Title]			[Instructor]		
Seminar in Applied Chemistry IA			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA602	1	Applied Chemistry	1st Semester		English/ Japanese

[Outline and purpose]

Students assigned to each laboratory acquire experimental and analysis methods to accomplish their master's thesis with skills in literature search, data collection, and utilization of international journals. Furthermore, the students obtain communication and presentation skills by studying how to approach the wide field and subject from the international viewpoints to cultivate the problem-solving ability and creative mind.

[Objectives]

To acquire analysis method required for professional engineers with advanced expertise.
To obtain communication and presentation skills by studying how to approach the wide field and subject from the international viewpoints.

[Requirements]

This seminar requires basic knowledge of each courses obtained in your undergraduate program.

[Evaluation]

Your academic supervisors evaluate your degree of attainment.

[Textbooks]

[References]

Textbooks, reference books, and articles related to your master's thesis prescribed by your supervisors.

[Schedule]

The method of lesson is decided after discussing between the supervisor and students.

1. Selection of research subject 1
2. Selection of research subject 2
3. Literature search
4. Previous research investigation 1
5. Previous research investigation 2
6. Previous research investigation 3
7. Acquisition of relevant information and knowledge 1
8. Acquisition of relevant information and knowledge 2
9. Acquisition of relevant information and knowledge 3
10. Reading of international journals to obtain the relevant information and knowledge 1
11. Reading of international journals to obtain the relevant information and knowledge 2
12. Reading of international journals to obtain the relevant information and knowledge 3
13. Reading of international journals to obtain the relevant information and knowledge 4
14. Reading of international journals to obtain the relevant information and knowledge 5
15. Reading of international journals to obtain the relevant information and knowledge 6

[Title]			[Instructor]		
Seminar in Applied Chemistry IB			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA603	1	Applied Chemistry	2nd Semester		English/ Japanese

[Outline and purpose]

Students assigned to each laboratory propose experimental design and conduct preliminary research study under the guidance of their supervisors. Furthermore, the students obtain communication and presentation skills by studying how to approach the wide field and subject from the international viewpoints to cultivate the problem-solving ability and creative mind.

[Objectives]

To carry out a novel research based on the study of Seminar in Applied Chemistry IA.

[Requirements]

This seminar requires basic knowledge of each courses obtained in your undergraduate program.

[Evaluation]

Your academic supervisors evaluate your degree of attainment.

[Textbooks]

[References]

Textbooks, reference books, and articles related to your master's thesis prescribed by your supervisors.

[Schedule]

The method of lesson is decided after discussing between the supervisor and students.

1. Previous research investigation 1
2. Previous research investigation 2
3. Previous research investigation 3
4. Experimental design 1
5. Experimental design 2
6. Experimental design 3
7. Preparation of preliminary research 1
8. Preparation of preliminary research 2
9. Preparation of preliminary research 3
10. Preliminary research study 1
11. Preliminary research study 2
12. Preliminary research study 3
13. Preparation of interim presentation 1
14. Preparation of interim presentation 2
15. Preparation of interim presentation 3

[Title]			[Instructor]		
Seminar in Applied Chemistry IIA			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA604	1	Applied Chemistry	1st Semester		English/ Japanese

[Outline and purpose]

Students assigned to each laboratory acquire experimental and analysis methods to accomplish their master's thesis with skills in literature search, data collection, and utilization of international journals based on the study of Seminar in Applied Chemistry IB. Furthermore, the students obtain communication and presentation skills by studying how to approach the wide field and subject from the international viewpoints to cultivate the problem-solving ability and creative mind.

[Objectives]

To acquire analysis method required for professional engineers with advanced expertise.
To obtain communication and presentation skills by studying how to approach the wide field and subject from the international viewpoints.

[Requirements]

This seminar requires basic knowledge of each courses obtained in your undergraduate program.

[Evaluation]

Your academic supervisors evaluate your degree of attainment.

[Textbooks]

[References]

Textbooks, reference books, and articles related to your master's thesis prescribed by your supervisors.

[Schedule]

The method of lesson is decided after discussing between the supervisor and students.
1. Examination of preliminary results and review of research plan 1
2. Examination of preliminary results and review of research plan 2
3. Examination of preliminary results and review of research plan 3
4. Research and investigation 1
5. Research and investigation 2
6. Research and investigation 3
7. Research and investigation 4
8. Research and investigation 5
9. Research and investigation 6
10. Research and investigation 7
11. Research and investigation 8
12. Research and investigation 9
13. Research and investigation 10
14. Research and investigation 11
15. Research and investigation 12

[Title]			[Instructor]		
Seminar in Applied Chemistry IIB			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA605	1	Applied Chemistry	2nd Semester		English/ Japanese

[Outline and purpose]

Students assigned to each laboratory summarize and publish the research results provided by Seminar in Applied Chemistry IIA under the guidance of their supervisors.

[Objectives]

To carry out a novel research based on the study of Seminar in Applied Chemistry IIA.

[Requirements]

This seminar requires basic knowledge of each courses obtained in your undergraduate program.

[Evaluation]

Your academic supervisors evaluate your degree of attainment.

[Textbooks]

[References]

Textbooks, reference books, and articles related to your master's thesis prescribed by your supervisors.

[Schedule]

The method of lesson is decided after discussing between the supervisor and students.

1. Evaluation of research and investigation, examination of additional study and investigation 1
2. Evaluation of research and investigation, examination of additional study and investigation 2
3. Evaluation of research and investigation, examination of additional study and investigation 3
4. Additional study and investigation 1
5. Additional study and investigation 2
6. Additional study and investigation 3
7. Contents of Master's thesis 1
8. Contents of Master's thesis 2
9. Contents of Master's thesis 3
10. Writing of Master's thesis 1
11. Writing of Master's thesis 2
12. Writing of Master's thesis 3
13. Oral presentation 1
14. Oral presentation 2
15. Oral presentation 3

[Title]			[Instructor]		
Research Work in Applied Chemistry IA			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA606	2	Applied Chemistry	1st Semester		English/ Japanese

[Outline and purpose]

Students assigned to each laboratory acquire experimental and analysis methods to accomplish their master's thesis with skills in literature search, data collection, and utilization of international journals. Furthermore, the students obtain communication and presentation skills by studying how to approach the wide field and subject from the international viewpoints to cultivate the problem-solving ability and creative mind.

[Objectives]

To acquire analysis method required for professional engineers with advanced expertise.
To obtain communication and presentation skills by studying how to approach the wide field and subject from the international viewpoints.

[Requirements]

This seminar requires basic knowledge of each courses obtained in your undergraduate program.

[Evaluation]

Your academic supervisors evaluate your degree of attainment.

[Textbooks]

[References]

Textbooks, reference books, and articles related to your master's thesis prescribed by your supervisors.

[Schedule]

As a general rule, seminars are held in classrooms and labs, but in other cases, the supervisor decides in consultation with the students.

1. Selection of research subject 1
2. Selection of research subject 2
3. Literature search
4. Previous research investigation 1
5. Previous research investigation 2
6. Previous research investigation 3
7. Acquisition of relevant information and knowledge 1
8. Acquisition of relevant information and knowledge 2
9. Acquisition of relevant information and knowledge 3
10. Reading of international journals to obtain the relevant information and knowledge 1
11. Reading of international journals to obtain the relevant information and knowledge 2
12. Reading of international journals to obtain the relevant information and knowledge 3
13. Reading of international journals to obtain the relevant information and knowledge 4
14. Reading of international journals to obtain the relevant information and knowledge 5
15. Reading of international journals to obtain the relevant information and knowledge 6

[Title]			[Instructor]		
Research Work in Applied Chemistry IB			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA607	2	Applied Chemistry	2nd Semester		English/ Japanese

[Outline and purpose]

Students assigned to each laboratory propose experimental design and conduct preliminary research study under the guidance of their supervisors. Furthermore, the students obtain communication and presentation skills by studying how to approach the wide field and subject from the international viewpoints to cultivate the problem-solving ability and creative mind.

[Objectives]

To carry out a novel research based on the study of Research Work in Applied Chemistry IA.

[Requirements]

This seminar requires basic knowledge of each courses obtained in your undergraduate program.

[Evaluation]

Your academic supervisors evaluate your degree of attainment.

[Textbooks]

[References]

Textbooks, reference books, and articles related to your master's thesis prescribed by your supervisors.

[Schedule]

As a general rule, seminars are held in classrooms and labs, but in other cases, the supervisor decides in consultation with the students.

1. Previous research investigation 1
2. Previous research investigation 2
3. Previous research investigation 3
4. Experimental design 1
5. Experimental design 2
6. Experimental design 3
7. Preparation of preliminary research 1
8. Preparation of preliminary research 2
9. Preparation of preliminary research 3
10. Preliminary research study 1
11. Preliminary research study 2
12. Preliminary research study 3
13. Preparation of interim presentation 1
14. Preparation of interim presentation 2
15. Preparation of interim presentation 3

[Title]			[Instructor]		
Research Work in Applied Chemistry IIA			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA608	2	Applied Chemistry	1st Semester		English/ Japanese

[Outline and purpose]

Students assigned to each laboratory acquire experimental and analysis methods to accomplish their master's thesis with skills in literature search, data collection, and utilization of international journals based on the study of Research Work in Applied Chemistry IB. Furthermore, the students obtain communication and presentation skills by studying how to approach the wide field and subject from the international viewpoints to cultivate the problem-solving ability and creative mind.

[Objectives]

To acquire analysis method required for professional engineers with advanced expertise.
To obtain communication and presentation skills by studying how to approach the wide field and subject from the international viewpoints.

[Requirements]

This seminar requires basic knowledge of each courses obtained in your undergraduate program.

[Evaluation]

Your academic supervisors evaluate your degree of attainment.

[Textbooks]

[References]

Textbooks, reference books, and articles related to your master's thesis prescribed by your supervisors.

[Schedule]

As a general rule, seminars are held in classrooms and labs, but in other cases, the supervisor decides in consultation with the students.

1. Examination of preliminary results and review of research plan 1
2. Examination of preliminary results and review of research plan 2
3. Examination of preliminary results and review of research plan 3
4. Research and investigation 1
5. Research and investigation 2
6. Research and investigation 3
7. Research and investigation 4
8. Research and investigation 5
9. Research and investigation 6
10. Research and investigation 7
11. Research and investigation 8
12. Research and investigation 9
13. Research and investigation 10
14. Research and investigation 11
15. Research and investigation 12

[Title]			[Instructor]		
Research Work in Applied Chemistry IIB			all academic supervisors		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTA609	2	Applied Chemistry	2nd Semester		English/ Japanese

[Outline and purpose]

Students assigned to each laboratory summarize and publish the research results provided by Research Work in Applied Chemistry IIA under the guidance of their supervisors.

[Objectives]

To carry out a novel research based on the study of Research Work in Applied Chemistry IIA.

[Requirements]

This seminar requires basic knowledge of each courses obtained in your undergraduate program.

[Evaluation]

Your academic supervisors evaluate your degree of attainment.

[Textbooks]

[References]

Textbooks, reference books, and articles related to your master's thesis prescribed by your supervisors.

[Schedule]

As a general rule, seminars are held in classrooms and labs, but in other cases, the supervisor decides in consultation with the students.

1. Evaluation of research and investigation, examination of additional study and investigation 1
2. Evaluation of research and investigation, examination of additional study and investigation 2
3. Evaluation of research and investigation, examination of additional study and investigation 3
4. Additional study and investigation 1
5. Additional study and investigation 2
6. Additional study and investigation 3
7. Contents of Master's thesis 1
8. Contents of Master's thesis 2
9. Contents of Master's thesis 3
10. Writing of Master's thesis 1
11. Writing of Master's thesis 2
12. Writing of Master's thesis 3
13. Oral presentation 1
14. Oral presentation 2
15. Oral presentation 3