[Title]			[Instructor]		
Coordination Chemistry			Hideto Sakane		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325530	2	Applied Chemistry	1st Semester	Mon.／II	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).

[Objectives]

Students are to be got learned in structure, bonding, and spectrochemical properties of transition metal complexes and to be able to name the coordination compounds

[Requirements]

Expertise of general inorganic, physical, and quantum chemistry.

[Evaluation]

Reports to the questions given in several hours.

[Textbooks]

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 －, 東京化学同人, ISBN:9784807907557 (in Japanese).

[References]

1. 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, 東京化学同人, ISBN:4807905511 (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:478532404X (in Japanese).
3. 三吉 克彦, 金属錯体の構造と性質, 岩波書店, ISBN:400011042X (in Japanese).

[Schedule]

1. Coordination bond and complex
2. Structure of mononuclear complexes: from one to six coordination numbers
3. Structure of mononuclear complexes: from seven to twelve coordination numbers
4. Structure of polynuclear complexes
5. Structure of cluster complexes
6. Structure of chelate complexes
7. Isomerism of complexes
8. Nomenclatures
9. Interpretations of electronic state by valence bond theory
10. Crystal field theory
11. Ligand field theory
12. Electronic states of multi d-electron systems
13. Charge-transfer absorptions
14. Stability
15. Reactions

[Title]			[Instructor]		
Advanced Inorganic Materials Chemistry			Takahiro Takei		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325540	2	Special Educational Program for Green Energy Conversion Science and Technology	2nd Semester	Mon.／I	English／Japanese

[Outline and purpose]

The behavior and mechanisms of electrical, magnetic and optical properties which are significant properties of solid materials will be lectured over from the basics. The aim of this lecture is acquisition of relationship between crystal structure and the electrical, magnetic and optical properties.

[Objectives]

1. To understand behavior and mechanism of electrical, magnetic and optical properties
2. To acquire consideration competency for correlation of electrical, magnetic and optical properties with the crystal structure, sorts of bond and composed elements of the solid

[Requirements]

Crystal structure of solid state materials

[Evaluation]

examinations: 30%
reporting assignment / mini-exam : 30%
attendance / attitude : 30%
presentation : 10%

[Textbooks]

Anthony R. West, Basic Solid State Chemistry, Second Edition, JOHN WILEY & SONS, LTD,
ISBN:0-471-98756-5

[References]

[Schedule]

1. Metallic conductivity
2. Superconductivity I
3. Superconductivity II
4. Semiconductivity
5. Ionic conductivity : metal halides
6. Ionic conductivity : solid electrolytes I
7. Ionic conductivity : solid electrolytes II
8. Ionic conductivity : solid electrolytes III
9. Dielectric materials, Ferroelectricity, Pyroelectricity and Piezoelectricity
10. Magnetic properties : behavior substances in a magnetic field
11. Magnetic properties : superexchange interaction
12. Magnetic properties : examples of materials I
13. Magnetic properties : examples of materials II
14. Optical properties
15. Final examination

[Title]			[Instructor]		
Advanced Solid State Physics and Chemistry			Naoki Yoneyama		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325545	2	Applied Chemistry	1st Semester	Tue. ／I	English／Japanese

[Outline and purpose]

Solid state physics and chemistry, which is a fundamental principle of functional materials, is treated in this lecture after quantum chemistry and chemical bonding theory. By reading an English review of organic conductors (charge transfer salts), basic ability to study the electronic properties of metal and insulators is improved.

[Objectives]

To understand the band theory on the basis of a nearly free electron and tight-binding approximations.
To understand the strongly correlated electron systems characteristic of organic conductors.

[Requirements]

Basic physics and chemistry learned in undergraduate.

[Evaluation]

report: 40 %
attendance: 60 %

[Textbooks]

T. Mizoguchi, Fundamentals of Materials Science - Solid State Physics (Japanese), Shokabo, ISBN: 4785320346

[References]

None.

[Schedule]

1: Atomic structure and X-ray
2: Chemical bonding theory
3: Crystal lattices and Bravais lattice
4: Free electron gas
5: Reciprocal lattice
6: Periodic potential and nearly free electron model
7: Tight-binding model and molecular orbitals
8: Introduction to strongly correlated electron systems
9: Mott insulator and superconductivity
10: Review of organic conductors I
11: Review of organic conductors II
12: Review of organic conductors III
13: Review of organic conductors IV
14: Review of organic conductors V
15:Summary

[Title]			[Instructor]		
Advanced Ceramics I			Takahiro Takei		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325550	2	Applied Chemistry	1st Semester	Mon.／I	English／Japanese

[Outline and purpose]

Solid state chemistry is one of the most important basic subjects in the field of green energy conversion technology. Many of the properties and applications of crystalline inorganic materials revolve around a surprisingly small number of structure types. We will study basics of solid state chemistry to understand the crystal structures, bonding types, and electronic structures, which affect various properties of solid materials. In addition, characteristics of the crystal structures and bonding types in solid oxide materials will be studied.

[Objectives]

1. To understand the crystal structures and bonding in solids as the basic knowledge of solid state chemistry.
2. To acquire competency for correlating various properties of materials (magnetic, electric, optic, etc.) with the crystal structures, bonding types, and constituent elements.

[Requirements]

Basic knowledge on inorganic chemistry (periodic table, crystal structure)

[Evaluation]

Examinations: 30%
Reports (homework) & mini-exam. : 30%
Mark given for class participation : 30%
Presentation : 10%

[Textbooks]

Anthony R. West, Basic Solid State Chemistry, Second Edition, JOHN WILEY & SONS, LTD,
ISBN:0-471-98756-5

[References]

None

[Schedule]

1. Crystal system, symmetry, and Bravais lattice
2. Lattice plane, Miller indices, and d-spacing
3. Crystal structures (CCP, HCP and FCC)
4. Materials with closed packed structure
5. Structures built of space-filling polyhedra
6. Rock salt, zinc blend, sphalerite, diamond, wurtzite and other AX structures
7. Rutile, cadmium iodide, cadmium chloride, perovskite, tungsten bronze, spinel and silicates
8. Ionic bonding and ionic radii
9. Lattice energy of ionic crystals
10. Exercises for questions at the end of the textbook
11. Partial covalent bonding / Bond valence and bond length
12. Non-bonding electron effects
13. Metallic bonding
14. Band structure of metal, insulator and semiconductors / Band structure of inorganic solids
15. Examinations and commentaries

[Title]			[Instructor]		
Advanced Ceramics II			Satoshi Watauchi / Yoshinori Yonezaki		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325560	2	Applied Chemistry	1st Semester	Thu.／I	English／Japanese

[Outline and purpose]

For an understanding of the basic concept of crystal growth, thermodynamics of crystal growth is lectured. In addition, for a better understanding of ceramics, the concepts of point groups and space groups are lectured from the viewpoint of group theory.

[Objectives]

To understand the basic theory of crystal growth on thermodynamics
To image structural features from space group notations

[Requirements]

Basic knowledge on thermodynamics, symmetry operations and stereogram

[Evaluation]

Examinations: 80%
Reports (homework) & mini-exam. : 10%
Mark given for class participation : 10%
Presentation : 10%

[Textbooks]

[References]

H. J. Scheel and T. Fukuda, “Crystal Growth Technology”, WILEY

[Schedule]

1 Chemical applications of group theory, Set
2 Group
3 Symmetry elements and Symmetry operations
4 Crystallographic point groups
5 Lattice, Unit cell, Bravais lattice
6 Symmorphic space groups
7 Nonsymmorphic space groups
8 Phase equilibria
9 Crystal Structure and atomic arrangement on surface
10 Nucleation
11 Surface energy
12 Equilibrium shape of crystal
13 Principle of growth
14 Mechanism of crystal growth
15 Examinations and commentaries

[Title]			[Instructor]		
Advanced Dielectrics			Satoshi Wada / Hiroshi Yanagi		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325570	2	Applied Chemistry	2nd Semester	Thu.／I	English／Japanese

[Outline and purpose]

In this lecture, basic science and application of dielectrics and ferroelectrics will be lectured.

[Objectives]

To understand basic science and application of dielectrics and ferroelectrics.

[Requirements]

[Evaluation]

Comprehensive evaluation

[Textbooks]

[References]

[Schedule]

1. Introduction
2. Basic understanding of electric circuit
3. Mechanism of electrical polarization
4. Complex dielectric constants and its relaxation
5. Ferroelectricity
6. Ferroelectric phase transition phenomena
7. Evaluation of dielectric and ferroelectric properties
8. Ferroelectric domain configuration
9. Piezoelectricity
10. High-frequency dielectric property
11. Application of dielectrics and ferroelectrics
12. Piezoelectric effect
13. Pyroelectric effect
14. Future of dielectrics and ferroelectrics
15. Estimation and summary

[Title]			[Instructor]		
Advanced Quantum Chemistry for Energy Device I			Hiroshi Irie		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325715	2	Applied Chemistry	1st Semester	Thu.／II	English／Japanese

[Outline and purpose]

A light-related system is one of the candidate technologies for sustainable energy conversion and environmental preservation. We will learn such light-related systems based on mainly physical chemistry as well as quantum chemistry and solid state physics.

[Objectives]

1. To understand the interaction of light with solids, and successive phenomena

[Requirements]

Physical Chemistry, Quantum chemistry, Solid state physics

[Evaluation]

Report: 50%
Attendance: 50%

[Textbooks]

[References]

魚崎浩平、米田龍、高橋誠、金子晋（共訳）：固体の電子構造と化学、技報堂出版、1989 年（in Japanese）

[Schedule]

1. Introduction
2. Light, wave-particle durability 1
3. Light, wave-particle durability 2
4. Band theory 1
5. Band theory 2
6. Interaction of light with solids
7. Solar energy conversion 1: To chemical energy 1
8. Solar energy conversion 1: To chemical energy 2
9. Solar energy conversion 2: To hydrogen energy 1
10. Solar energy conversion 2: To hydrogen energy 2
11. Solar energy conversion 3: To electricity 1
12. Solar energy conversion 3: To electricity 2
13. Energy conversion: Heat to electricity 1
14. Energy conversion: Heat to electricity 2
15. Summary

[Title]			[Instructor]		
Advanced Quantum Chemistry for Energy Device Ⅱ			Tetsuya Sato		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325716	2	Applied Chemistry	1st Semester	Thu.／II	English／Japanese

[Outline and purpose]

Plasma processing is a high-technology discipline born out of the need access a parameter space in materials processing unattainable by strictly chemical methods. The filed is interdisciplinary, combining the areas of plasma physics, surface science, gas-phase chemistry, and atomic and molecular physics. This lecture discusses the fundamental principles of partially ionized, chemically reactive plasma discharges and their use in thin-film processing.

[Objectives]

1. to understand the fundamental principles of plasma discharges
2. to understand the gas- and surface-phase chemical reactions
3. to understand the plasma-assisted deposition, implantation, and surface modification
4. to understand the materials processing for energy device

[Requirements]

Physical Chemistry, Quantum Chemistry, Electromagnetism

[Evaluation]

homework /examination : 70 %
presentation : 20 %
audit attitude : 10 %

[Textbooks]

Michael A. Lieberman, *Principles of Plasma Discharges and Materials Processing, 2nd Edition,* Wiley-Inter science , ISBN:0471720011

[References]

[Schedule]

1. Introduction
2. Basic plasma equations and equilibrium
3. Atomic collisions, plasma dynamics
4. Diffusion and transport, DC sheaths
5. Chemical reactions and equilibrium
6. Molecular collisions, chemical kinetics and surface processes
7. DC discharges
8. Capacitive discharges
9. Inductive discharges, wave-heated discharges
10. Etching
11. Deposition and implantation
12. Applications I: Synthesize of thin film semiconductor for solar cells
13. Applications II: Decomposition of the greenhouse gases
14. Applications III: Advanced materials for quantum devices
15. Evaluation

[Title]			[Instructor]		
Advanced Course of Polymer Material Chemistry I			Hidenori Okuzaki		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325580	2	Applied Chemistry	2nd Semester	Thu.／II	Japanese

[Outline and purpose]

This lecture deals with the basic chemistry, properties, and evaluation methods of polymer materials aimed at understanding the polymer material chemistry.

[Objectives]

To learn advanced expertise about structures and functions of functional polymer materials.

[Requirements]

A grounding in organic chemistry, physical chemistry, and polymer chemistry of the undergraduate program.

[Evaluation]

Lecture attendance attitude: 50%
Presentation: 50%

[Textbooks]

[References]

[Schedule]

1. Introduction
2. Stereoregularity and tacticity of polymers
3. Basic properties of polymers
4. Molecular weight of polymers
5. Polydispersity index of polymers
6. Wide-angle X-ray diffraction of polymers
7. Evaluation of structure factor of polymers
8. Molecular orientation of polymers
9. Crystalline structure of polymers
10. Crystallization kinetics of polymers
11. Tensile properties of polymers
12. Dynamic viscoelastic properties of polymers
13. Dielectric properties of polymers
14. Electrical conductivity of polymers
15. Total evaluation and presentation

[Title]			[Instructor]		
Advanced Course of Polymer Material Chemistry II			Akihiro Suzuki		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325590	2	Applied Chemistry	2nd Semester	Thu.／II	Japanese

[Outline and purpose]

The polymer materials are used in aviation, space, electricity, an electron, communication, transportation, and medical care. The mechanism of the function and the characteristic about functional polymeric materials used in each field are discussed and illustrated.

[Objectives]

To understand the application of polymers in many fields

[Requirements]

a grounding in properties of polymer and polymer synthesis

[Evaluation]

homework etc.: 30%
final examination:70%

[Textbooks]

[References]

岡村誠三、中島章夫、小野木重治、河合弘迪、西島安則、東村敏延、伊勢典夫（共著）:高分子化学序論、化学同人、1981 年（in Japanese）

[Schedule]

1. Introduction
2. Characteristics of optical plastics
3. Optical plastics (Lens)
4. Plastic optical Fiber
5 Optical plastics (Disc)
6. Mechanism of adhesion
7. Prescribed properties of adhesive
8. Adhesive (epoxy adhesive, superglue)
9. Mechanism of photosensitive resin
10.Reaction of photosensitive resin
11. Mechanism of separation membrane
12. Preparation and application of separation membrane
13. Medical application of polymers
14. Final examination (Presentation)
15. Final examination (Presentation)

[Title]			[Instructor]		
Advanced Organic Material Chemistry I			Tetsuo Kuwabara		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325600	2	Applied Chemistry	1st Semester	Fri.／I	Japanese

[Outline and purpose]

This course addresses the synthesis and the properties of organic functional and supramolecular materials.

[Objectives]

To understand the synthesis and the functional properties of organic and supramolecular materials.

[Requirements]

Organic chemistry, Physical chemistry, Polymer chemistry.

[Evaluation]

Report and class participation : 70 %
Presentation : 20 %
Attitude : 10 %

[Textbooks]

[References]

[Schedule]

1. Introduction
2. Molecular structures
3. Molecular properties
4. Intermolecular interaction
5. Molecular recognition
6. Self-assembly
7. Biomimics
8. Supramolecular chemistry
9. Crown ether
10. Cyclophane
11. Cyclodextrin
12. Dendrimer
13. Rotaxane
14. Catenane
15. Summary and discussion

[Title]			[Instructor]		
Advanced Organic Material Chemistry II			Yuichiro Haramoto		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325610	2	Applied Chemistry	1st Semester	Fri.／I	Japanese

[Outline and purpose]

Syntheses and functional mechanism of Organic functional materials are lectured.
To learn syntheses and functional mechanism of Organic functional materials.

[Objectives]

To understand syntheses and functional mechanism of Organic functional materials.

[Requirements]

Organic chemistry, Physical chemistry.

[Evaluation]

Report 80%, attitude in lesson 20%.

[Textbooks]

[References]

[Schedule]

1. Chemical controlled release-1
2. Chemical controlled release-2
3. Photochromism-1
4. Photochromism-2
5. Introduction of Liquid Crystal
6. Liquid Crystalline Molecules and Syntheses
7. Liquid Crystalline Phase
8. Liquid Crystalline Polymer
9. Ferroelectric Liquid Crystal
10. Ionic Liquid Crystal
11. Liquid Crystalline Semiconductor
12. Conductive Liquid Crystalline Memory
13. Electro luminescence
14. Possibility of Organic Functional Materials
15. Final Discussion

[Title]			[Instructor]		
Advanced Inorganic Instrumental Analysis			Susumu Kawakubo / Yasutada Suzuki		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325620	2	Applied Chemistry	1st Semester	Wed.／II	English／Japanese*

[Outline and purpose]

Surface analytical techniques are useful for development and quality control of high-performance materials in electronics. This lecture covers understanding of principles, instrumentations and applications of surface analyses. You visit the Center for Instrumental Analysis in Kofu campus and have brief lectures about real analytical instruments and Q&A time. You also read academic articles to be familiar with modern inorganic instrumental analysis.

[Objectives]

1. Understanding of typical surface analytical techniques; principles, instrumentations and applications
2. Proper interpretation of analysis data and appropriate choice of analytical technique for different types of analytical samples

[Requirements]

This program requires you to be familiar with analytical techniques and instrumental methods studied in undergraduate programs.

[Evaluation]

report and/or midterm examination : 50%
presentation skill and scientific understanding of scientific literature : 30%
attendance : 20%

[Textbooks]

Prints

[References]

None

[Schedule]

1. Introduction
2.1 Electron probe technique - Electron microscope (TEM/SEM)
2.2 Electron probe technique - Electron Probe Microanalysis,
2.3 Electron probe technique - Auger electron Spectroscopy
3.1 Electron probe technique - Electron diffractometry (LEED/RHEED)
3. 2 X-ray technique - X-ray Photoelectron Spectroscopy
4. First midterm examination
5. Ion probe technique - Secondary Ion Mass Spectroscopy
6. Ion probe technique - Rutherford Back Scattering Spectroscopy
7. Other surface analytical techniques
8. Second midterm examination
9. Tour of the Center for Instrumental Analysis I
10. Tour of the Center for Instrumental Analysis II
11. English reading skills of academic articles I
12. English reading skills of academic articles II
13. English reading skills of academic articles III
14. English reading skills of academic articles IV
15. Review for final

*If all students in this program request English lecture

[Title]			[Instructor]		
Advanced Organic Instrumental Analysis I			Hitoshi Koizumi		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325630	2	Applied Chemistry	1st Semester	Fri.／II	Japanese*

[Outline and purpose]

This course addresses the separation methods, extend a special favor to Chromatography.
Chromatography techniques are the most useful methods for isolation and purification of compounds.
By reading an English review of Chromatography, students become more familiar with fundamental principle and applications in Chromatography.

[Objectives]

1. Understanding of Chromatography ; principles, instrumentations and applications
2. Understanding Recent Separation method ; Supercritical Fluid Chromatography, Capillary Electrophoresis

[Requirements]

This program requires you to be familiar with chemistry subjects studied in undergraduate programs.

[Evaluation]

report: 80%
attendance: 20 %

[Textbooks]

Prints

[References]

Analytical Chemistry, 6th edition Gary D. Christian (ISBN4-621-07555-1)

[Schedule]

1 Outline of Chromatography
2 Principle of Separation in Chromatography
3 High Performance Liquid Chromatography ; Separation column and Detection
4 High Performance Liquid Chromatography ; Selection of separation methods for samples
5 Ion Chromatography
6 Supercritical Fluid Chromatography
7 Capillary Electrophoresis
8-14 Discussion of article on Chromatography
15 Summary

[Title]			[Instructor]		
Advanced Organic Instrumental Analysis II			Kazue Tani		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325640	2	Applied Chemistry	1st Semester	Fri.／II	Japanese

[Outline and purpose]

This lecture covers understanding of principle, instrumentations and applications of ^{1}H- and ^{13}C NMR spectroscopy.

[Objectives]

To understand the principle of NMR spectroscopy, estimate the structure of simple compounds from the NMR spectra and molecular formulas.

[Requirements]

This program requires you to be familiar with organic chemistry studied in undergraduate programs.

[Evaluation]

report and/or midterm examination：60%
presentation skill and scientific understanding of scientific literature：40%

[Textbooks]

Prints

[References]

None

[Schedule]

1. ^{1}H-NMR spectroscopy, theory and apparatus
2. Chemical shift, relaxation
3. Prediction of chemical shift
4. Spin-spin coupling, coupling constants
5. First order rules, Pople' nomenclature for spin systems
6. Protons on Heteroatoms
7. Equivalence in NMR
8. Chirality, geminal and vicinal-spin coupling
9. Long-range coupling, spin-decoupling, nuclear overhauser effect (NOE)
10. ^{13}C NMR spectroscopy, theory
11. Peak attribution
12. Chemical species and chemical shift
13. ^{13}C-^{1}H spin coupling, DEPT
14. Identification of ^{1}H- and ^{13}C- NMR spectroscopy
15. Presentation of spectral analysis

[Title]			[Instructor]		
Synthetic Polymer Chemistry			Makoto Obata		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325645	2	Applied Chemistry	1st Semester	Tue.／II	Japanese

[Outline and purpose]

Polymeric materials are indispensable for our modern life. Polymer synthesis have been developed very rapidly, and now we can synthesize quite sophisticated polymers with well-designed architecture by precise polymerization. In this lecture, you learn basics of polymer synthesis and emerging techniques of precise polymerizations as well.

[Objectives]

1. to understand fundamental mechanisms of polymer formations
2. to understand basic concepts for precise polymerization to build sophisticated architecture.

[Requirements]

good groundings of organic chemistry, physical chemistry (especially, kinetics) and fundamental polymer science.

[Evaluation]

reports：50%
attendance and presentation：50 %

[Textbooks]

none

[References]

大津隆行, 改訂 高分子合成の化学, 化学同人 (ISBN:4-7598-0137-5)（in Japanese）
遠藤剛　編, 高分子の合成（上）　ラジカル重合・カチオン重合・アニオン重合, 講談社 (ISBN:978-4-06-154361-4)（in Japanese）
遠藤剛　編, 高分子の合成（下）　開環重合・重縮合・配位重合, 講談社 (ISBN:978-4-06-154362-1)（in Japanese）

[Schedule]

1. Introduction of Polymer Science (classification of polymers, basic characterizations, etc.)
2. Radical Polymerization 1 (elementary reactions, kinetics, molecular weight distributions)
3. Radical Polymerization 2 (copolymerizations, statistical analysis)
4. Radical Polymerization 3 (monomer reactivity, Q-e scheme)
5. Ionic Polymerization 1 (elementary reactions, kinetics)
6. Ionic Polymerization 2 (monomer reactivity)
7. Ionic Polymerization 3 (details)
8. Coordination Polymerization
9. Stereospecificity in Polymerization of Vinyl Monomers (stereoregular and asymmetric polymerizations)
10. Metathesis Polymerization (ROMP, ADMET), Ring-Opening Polymerization 1
11. Ring-Opening Polymerization 2
12. Stepwise Polymerization 1 (elementary reactions, kinetics, molecular weight distributions)
13. Stepwise Polymerization 2 (details)
14. Controlled Radical Polymerization (NMP, ATRP)
15. Controlled Radical Polymerization (RAFT)

[Title]			[Instructor]		
Advanced Course of Design for Advanced Inorganic Materials			Isao Tanaka / Nobuhiro Kumada		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTG515	2	Special Educational Program for Green Energy Conversion Science and Technology	2nd Semester	Tue.／I	English／Japanese

[Outline and purpose]

Crystal structure, crystal defects, functions and property of functional inorganic compounds are acquired as combined with scientific research fields of inorganic industrial chemistry, crystal engineering, materials engineering. Also recent topics about properties, characterization and crystal structures of functional inorganic compounds are discussed.

[Objectives]

1. to understand point group and non-stoichiometry of oxides
2. to understand drawing technique of crystal structure

[Requirements]

inorganic chemistry, solid state chemistry, materials engineering, physical chemistry, electronic physical properties

[Evaluation]

Homework/ examination : 70%
audit attitude : 10%
presentation : 20%

[Textbooks]

Anthony R. West, Basic Solid State Chemistry , Second Edition, John Wiley & Sons Ltd.,
ISBN: 978-1-119-94294-8

[References]

[Schedule]

1. Symmetry and crystal systems
2. Understanding point groups on the basis of symmetry
3. Microscopy of crystalline materials
4. Function and property by crystal defects
5. Non-stoichiomerty of oxides
6. Lattice defects in oxides
7. defect concentration and defect equilibrium
8. Basis of crystalline materials
9. Electrical and mechanical properties of crystalline materials
10. Chemical properties of crystalline materials
11. Characterization of physical properties
12. Relation between crystal structure and physical properties
13. Analysis technique of crystal structure
14. Recent topics
15. Summary

[Title]			[Instructor]		
Advanced Functional Materials			Nobuhiro Kumada / Isao Tanaka / Takahiro Takei		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
GTZ506	2	Advanced Material Science	1st Semester	Tue.／II	English／Japanese

[Outline and purpose]

Synthesis and crystal growth techniques for solid state materials are acquired on the base of phase equilibrium in this course. Also crystal chemistry, X-ray crystal structure analysis, characterization for solid state materials are acquired. For various synthesis processes, the mechanism and their theories are acquired.

[Objectives]

1. to understand phase equilibrium and the application of the phase equilibrium for synthesis techniques of solid state materials
2. to understand techniques of crystal structure analysis
3. to understand formation mechanism in various synthesis processes for solid state materials

[Requirements]

inorganic chemistry, solid state chemistry, materials engineering, physical chemistry, electronic physical properties

[Evaluation]

homework/ examination：70%
audit attitude：10%
presentation：20%

[Textbooks]

Anthony R. West, Solid State Chemistry and Its Applications, Second Edition, JOHN WILEY & SONS, LTD, ISBN:978-1-119-94294-8

[References]

[Schedule]

1. Rule about phase equilibrium
2. Understanding and application of monocomponent systems
3. Understanding and application of two component systems
4. Thermal analysis for preparation of phase diagrams
5. Fundamentals and applications of crystal growth
6. Synthesis techniques for materials
7. Inorganic chemistry and basis of solid state chemistry 1
8. Inorganic chemistry and basis of solid state chemistry 2
9. Fundamentals of crystal chemistry
10. Sol-gel synthesis of inorganic materials
11. Synthesis by hydrothermal reactions
12. Soft chemical reaction
13. Thin film preparation by gas phase reaction
14. Synthesis by electrochemical reactions
15. Summary

[Title]			[Instructor]		
Advanced Course of Materials Design for Fuel Cells I			Hiroyuki Uchida / Kenji Miyatake / Shinji Nohara		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325690	2	Applied Chemistry	2nd Semester	Tue.／II	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]

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

[References]

None

[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]		
Advanced Course of Design for Fuel Cells II			Kenji Miyatake / Hiroyuki Uchida / Shinji Nohara		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325700	2	Applied Chemistry	2nd Semester	Tue.／II	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]

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

[References]

None

[Schedule]

1. Fuel cells and polymers 1
2. Fuel cells and polymers 2
3. Proton conductive polymers for fuel cells (design and synthesis) 1
4. Proton conductive polymers for fuel cells (design and synthesis) 2
5. Proton conductive polymers for fuel cells (structure and properties) 1
6. Proton conductive polymers for fuel cells (structure and properties) 2
7. Proton conductive polymers for fuel cells (evaluation and application) 1
8. Proton conductive polymers for fuel cells (evaluation and application) 2
9. Component materials of SOFCs: solid electrolytes 1
10. Component materials of SOFCs: solid electrolytes 2
11. Component materials of SOFCs: electrodes 1
12. Component materials of SOFCs: electrodes 2
13. Intermediate-temperature SOFCs 1
14. Intermediate-temperature SOFCs 2
15. Summary

[Title]			[Instructor]		
Advanced Course of Applied Physical Chemistry I			Hiroshi Yanagi / Satoshi Wada		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325780	2	Applied Chemistry	2nd Semester	Thu.／I	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 Examination　40%
2 homework and reports　40%
3 class participation　20%

[Textbooks]

[References]

[Schedule]

1. Introduction
2. Crystal Structure
3. Chemical bonding and band structure
4. Spectroscopic methods
5. Other evaluation method
6. The essence of electronic structure
7. Material design based on electronic structure
8. Surfaces and interfaces
9. Preparation methods
10. Evaluation of impurity phase
11. Single-crystal growth
12. Thin film deposition methods
13. Epitaxial growth
14. Application for electronic devices
15. Summative assessment for total score

[Title]			[Instructor]		
Advanced Cource of Applied Physical Chemistry II			Masami Shibata		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325785	2	Applied Chemistry	2nd Semester	Thu.／I	Japanese

[Outline and purpose]

Students learn the basic and application of surface/interface science of materials. They can deeply understand the field of surface technology such as plating. This program is also a lecture on adsorption technology for evaluating the surface/pore of materials.

[Objectives]

To understand fundamental principle and application of solid-surface modification and its evaluation

[Requirements]

Basic knowledge of physical chemistry and electrochemistry

[Evaluation]

Examination 40%
Homework/Reports 40%
Class participation 20%

[Textbooks]

[References]

[Schedule]

1. Introduction
2. Outline of electrochemistry and surface finishing
3. Electroless plating (Basic)
4. Electroless plating (Advanced)
5. Electroplating (Basic)
6. Electroplating (Advanced)
7. Anodizing (Basic)
8. Interim appraisal
9. Adsorption theory I (surface and interface)
10. Adsorption theory II (physical adsorption and chemical adsorption)
11. Adsorption measurement method I (apparatus and isotherms)
12. Adsorption measurement method II (Analysis)
13. Production process and characteristics of adsorbent
14. Application of adsorption and separation technology
15. Summative assessment for total score

[Title]			[Instructor]		
Advanced Cource of Applied Physical Chemistry III			Naoya Miyajima		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325790	2	Applied Chemistry	2nd Semester	Thu.／I	Japanese

[Outline and purpose]

Students learn the basic and application of surface/interface science of materials. They can deeply understand the field of surface technology such as plating. This program is also a lecture on adsorption technology for evaluating the surface/pore of materials.

[Objectives]

To understand fundamental principle and application of solid-surface modification and its evaluation

[Requirements]

Basic knowledge of physical chemistry and electrochemistry

[Evaluation]

Homework/Reports 80%
Class participation 20%

[Textbooks]

[References]

[Schedule]

1. Introduction of Surface modification
2. Introduction of Adsorption
3. Surface/pore control
4. Adsorption theory I (surface and interface)
5. Adsorption theory II (physical adsorption and chemical adsorption)
6. Adsorption measurement method I (apparatus and isotherms)
7. Adsorption measurement method II (Analysis)
8. Interim appraisal
9. Applications of surface modification and adsorption theory
10. Applications of surface modification and adsorption
11. Applications of adsorption measurement method I (isotherms)
12. Applications of Adsorption measurement method II (Analysis)
13. Production process and characteristics of adsorbent
14. Adsorption and separation technology
15. Summative assessment for total score

[Title]			[Instructor]		
Presentation I			Each academic supervisor		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325730	2	Applied Chemistry	Full-year	／	English／Japanese

[Outline and purpose]

The presentation is one of the most important skills for scientists and engineers. We hope that our master course students should make a presentation in academic conferences.

[Objectives]

To cultivate the ability of presentation.

[Requirements]

[Evaluation]

Your academic supervisor evaluates the degree of attainment.

[Textbooks]

[References]

[Schedule]

This is a tutorial training through a whole year by your academic supervisor.

[Title]			[Instructor]		
Presentation II			Each academic supervisor		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325731	2	Applied Chemistry	Full-year	／	English／Japanese

[Outline and purpose]

The presentation is one of the most important skills for scientists and engineers. We hope that our master course students should make a presentation in academic conferences.

[Objectives]

To cultivate the ability of presentation.

[Requirements]

[Evaluation]

Your academic supervisor evaluates the degree of attainment.

[Textbooks]

[References]

[Schedule]

This is a tutorial training through a whole year by your academic supervisor.

[Title]			[Instructor]		
Internship			Each academic supervisor		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325740	2	Applied Chemistry	Intensive	／	English／Japanese

[Outline and purpose]

Reinforcing what you have learned in the master program by doing internship in public office, public corporation, and nonpublic corporation. Internships consist of two different types, which are collaborative project type and challenge type. You receive helpful guidance from a specialist in each field.

[Objectives]

1. Practical training for 2 weeks.
2. Put your education into practice
3. Create a highly-motivated mind on education in master program
4. Use the internship to design your career.

[Requirements]

1. Expertise in your particular line
2. Common sense as a member of society
3. Frame of mind to participate in internship representing your university

[Evaluation]

Comprehensive evaluation

[Textbooks]

[References]

[Schedule]

1. Application and Procedure
   (1) Collaborative project type: You fix the place and period of internship under the guidance of your academic supervisor. You make an internship proposal to administrator (teacher in charge of internship).
   (2) Challenge type: Applicants attend the internship guidance and get information on challenges from Career Center. You choose the place of internship and apply for internship to the office of curricular and educational.
2. Operation
3. Report and Presentation

[Title]			[Instructor]		
Seminar in Applied Chemistry IA			Each academic supervisor		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325801	1	Applied Chemistry	1st Semester	／	English／Japanese

[Outline and purpose]

Acquiring information and skills on the specialized field associated with master's thesis through reading the journals on applied chemistry. Making a presentation and discussion on the results of your experiments. Cultivating the problem-solving ability and creative mind.

[Objectives]

To obtain the information and skills required for accomplishing the study for master's thesis.
To apply the obtained information and skills to the study for master's thesis.

[Requirements]

[Evaluation]

Your academic supervisor evaluates the degree of attainment.

[Textbooks]

[References]

[Schedule]

Your academic supervisor organizes the schedule with respect to each subject of study.

[Title]			[Instructor]		
Seminar in Applied Chemistry IB			Each academic supervisor		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325802	1	Applied Chemistry	2nd Semester	／	English／Japanese

[Outline and purpose]

Acquiring information and skills on the specialized field associated with master's thesis through reading the journals on applied chemistry. Making a presentation and discussion on the results of your experiments. Cultivating the problem-solving ability and creative mind.

[Objectives]

To obtain the information and skills required for accomplishing the study for master's thesis.
To apply the obtained information and skills to the study for master's thesis.

[Requirements]

[Evaluation]

Your academic supervisor evaluates the degree of attainment.

[Textbooks]

[References]

[Schedule]

Your academic supervisor organizes the schedule with respect to each subject of study.

[Title]			[Instructor]		
Seminar in Applied Chemistry IIA			Each academic supervisor		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325811	1	Applied Chemistry	1st Semester	／	English／Japanese

[Outline and purpose]

Acquiring information and skills on the specialized field associated with master's thesis through reading the journals on applied chemistry. Making a presentation and discussion on the results of your experiments. Cultivating the problem-solving ability and creative mind.

[Objectives]

To obtain the information and skills required for accomplishing the study for master's thesis.
To apply the obtained information and skills to the study for master's thesis.

[Requirements]

[Evaluation]

Your academic supervisor evaluates the degree of attainment.

[Textbooks]

[References]

[Schedule]

Your academic supervisor organizes the schedule with respect to each subject of study.

[Title]			[Instructor]		
Seminar in Applied Chemistry IIB			Each academic supervisor		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325812	1	Applied Chemistry	2nd Semester	／	English／Japanese

[Outline and purpose]

Acquiring information and skills on the specialized field associated with master's thesis through reading the journals on applied chemistry. Making a presentation and discussion on the results of your experiments. Cultivating the problem-solving ability and creative mind.

[Objectives]

To obtain the information and skills required for accomplishing the study for master's thesis.
To apply the obtained information and skills to the study for master's thesis.

[Requirements]

[Evaluation]

Your academic supervisor evaluates the degree of attainment.

[Textbooks]

[References]

[Schedule]

Your academic supervisor organizes the schedule with respect to each subject of study.

[Title]			[Instructor]		
Research Work in Applied Chemistry IA			Each academic supervisor		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325821	2	Applied Chemistry	1st Semester	／	English／Japanese

[Outline and purpose]

Research studies on applied chemistry for master's thesis.

[Objectives]

1. Literature searching
2. Planning of experiment
3. Establishment of experimental method
4. Implementation of experiments
5. Data analysis
6. Presentation and discussion

[Requirements]

[Evaluation]

Your academic supervisor evaluates the degree of attainment.

[Textbooks]

[References]

[Schedule]

Your academic supervisor organizes the schedule with respect to each recipient.

[Title]			[Instructor]		
Research Work in Applied Chemistry IB			Each academic supervisor		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325822	2	Applied Chemistry	2nd Semester	／	English／Japanese

[Outline and purpose]

Research studies on applied chemistry for master's thesis.

[Objectives]

1. Literature searching
2. Planning of experiment
3. Establishment of experimental method
4. Implementation of experiments
5. Data analysis
6. Presentation and discussion

[Requirements]

[Evaluation]

Your academic supervisor evaluates the degree of attainment.

[Textbooks]

[References]

[Schedule]

Your academic supervisor organizes the schedule with respect to each recipient.

[Title]			[Instructor]		
Research Work in Applied Chemistry IIA			Each academic supervisor		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325831	3	Applied Chemistry	1st Semester	／	English／Japanese

[Outline and purpose]

Research studies on applied chemistry for master's thesis.

[Objectives]

1. Literature searching
2. Planning of experiment
3. Establishment of experimental method
4. Implementation of experiments
5. Data analysis
6. Presentation and discussion

[Requirements]

[Evaluation]

Your academic supervisor evaluates the degree of attainment.

[Textbooks]

[References]

[Schedule]

Your academic supervisor organizes the schedule with respect to each recipient.

[Title]			[Instructor]		
Research Work in Applied Chemistry IIB			Each academic supervisor		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
325832	3	Applied Chemistry	2nd Semester	／	English／Japanese

[Outline and purpose]

Research studies on applied chemistry for master's thesis.

[Objectives]

1. Literature searching
2. Planning of experiment
3. Establishment of experimental method
4. Implementation of experiments
5. Data analysis
6. Presentation and discussion

[Requirements]

[Evaluation]

Your academic supervisor evaluates the degree of attainment.

[Textbooks]

[References]

[Schedule]

Your academic supervisor organizes the schedule with respect to each recipient.