[Title]			[Instructor]		
Advanced Instrumental Analysis IA			Junji Yamanaka		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
320110A GTI501	1	For All Programs of “Division of Engineering”	Intensive	／	English／ Japanese

[Outline and purpose]

We will learn practical knowledge how to operate Transmission Electron Microscopes (TEM).

[Objectives]

First, we will learn about basic mechanical structure of TEM.
Then we will learn how to operate the TEM in the “Center for Instrumental Analysis.”

[Requirements]

1 (Mandatory): Completion of undergraduate course covering basic physics.
2 (Mandatory): Completion of undergraduate course covering basic chemistry.
3 (Mandatory): Completion of undergraduate course of laboratory class about science/engineering.
4 (Mandatory): Your supervisor must agree that you will use the TEMs in the “Center for Instrumental Analysis.”
5 (Optional): If you have a specific purpose to use TEM for your thesis, it will be desirable.

[Evaluation]

Quizzes and /or Reports: 50%
Practical Skills Examination: 50%

[Textbooks]

[References]

[Schedule]

1. What can we do using Transmission Electron Microscope (TEM)?
2. Principle of Transmission Electron Microscopy.
3. Basic Mechanical Structure of TEM.
4. How to check the condition of TEM in the “Center for Instrumental Analysis.”
5. Specimen Preparation and TEM Operation. Part 1.
6. Specimen preparation and TEM operation. Part 2.
7. Specimen preparation and TEM operation. Part 3.
8. Data Analysis. Part 1.
9. Data Analysis. Part 2.
10. Discussion and Summary.

*: It is required to receive the credit of this class in advance if you would like to use the TEMs in the “Center for Instrumental Analysis.”

*: If you already have the credit of the “Instrumental Analysis 1A”, which is for undergraduate, you don’t have to receive this credit to use the TEMs in the “Center for Instrumental Analysis.”

*: There are many options how to prepare the TEM specimens and how to operate the TEM. We can discuss which part should be learned precisely, at the beginning of this class.

[Title]			[Instructor]		
Advanced Instrumental Analysis IB			Junji Yamanaka / Tsutomu Muranaka / Takahiro Takei / Norio Onojima		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
320110B GTI502	1	For All Programs of "Division of Engineering"	Intensive Course	／	English／Japanese

[Outline and purpose]

We will learn practical knowledge how to operate Scanning Electron Microscopes (SEM).

[Objectives]

First, we will learn about basic mechanical structure of SEM.
Then we will learn how to operate the SEM in the "Center for Instrumental Analysis."

[Requirements]

1 (Mandatory): Completion of undergraduate course covering basic physics.
2 (Mandatory): Completion of undergraduate course covering basic chemistry.
3 (Mandatory): Completion of undergraduate course of laboratory class about science/engineering.
4 (Mandatory): Your supervisor must agree that you will use the SEMs in the "Center for Instrumental Analysis."
5 (Optional): If you have a specific purpose to use SEM for your thesis, it will be desirable.

[Evaluation]

Quizzes and /or Reports: 50%
Practical Skills Examination: 50%

[Textbooks]

[References]

[Schedule]

1. What can we do using Scanning Electron Microscope (SEM)?
2. Principle of Scanning Electron Microscopy.
3. Basic Mechanical Structure of SEM.
4. How to check the condition of SEM in the "Center for Instrumental Analysis."
5. Specimen Preparation and SEM Operation. Part 1.
6. Specimen preparation and SEM operation. Part 2.
7. Specimen preparation and SEM operation. Part 3.
8. Data Analysis. Part 1.
9. Data Analysis. Part 2.
10. Discussion and Summary.

*: It is required to receive the credit of this class in advance if you would like to use the SEMs in the "Center for Instrumental Analysis."

*: If you already have the credit of the "Instrumental Analysis 1B", which is for undergraduate, you don't have to receive this credit to use the SEMs in the "Center for Instrumental Analysis."

*: There are many options how to prepare the SEM specimens and how to operate the SEM. We can discuss which part should be learned precisely, at the beginning of this class.

[Title]			[Instructor]		
Advanced Instrumental Analysis IC			Isao Tanaka / Satoshi Watauchi / Yoichi Nabetani		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
320110C GTI503	1	For All Programs of "Division of Engineering"	Intensive	／	English／ Japanese

[Outline and purpose]

Electron microprobe analyzer (EPMA) is composed of a scanning electron microscope and an X-ray spectroscope. EPMA is useful for compositional analysis of solid surface with micrometer to centimeter size.
After understanding the principle and feature of EPMA, the measurement technique of electron microscope observation, X-ray qualitative analysis and quantitative analysis is acquired.

[Objectives]

1. Understanding principle and feature of EPMA
2. Mastering measurement technique of electron microscope observation
3. Mastering measurement technique of X-ray qualitative analysis
4. Mastering measurement technique of X-ray quantitative analysis

[Requirements]

Understanding X-ray diffraction method and spectroscopy

[Evaluation]

brief examination & homework: 50%
practice skill : 50%

[Textbooks]

[References]

[Schedule]

1. Purpose of measurement
2. Principle of EPMA measurement
3. Principle of EPMA analyzer
4. Maintenance of EPMA
5. Observation of scanning electron microscope (sample preparation and microscope operation)
6. Operation of X-ray qualitative analysis
7. Operation of X-ray quantitative analysis
8. Data analysis I (basic)
9. Data analysis II (application)
10. Summary

*1 You should get 1 credit for this class to use EPMA.
**2 If you have already gotten 1 credit for this class in undergraduate, you do not take this class.

[Title]			[Instructor]		
Advanced Instrumental Analysis ID			Tetsuya Sato		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
320110D GTI504	1	For All Programs of “Division of Engineering”	Intensive	／	Japanese

[Outline and purpose]

X-ray photoelectron spectroscopy (XPS) is useful for chemical characterization of thin films and surfaces because it is capable of readily providing information on the nature of chemical bonding and valence states. XPS is true surface analytical techniques, since the detection electrons are emitted from surface layers less than ～15 Å deep. After understanding the principle and measurement technique of XPS, qualitative analysis and quantitative analysis is acquired.

[Objectives]

1. Understanding principle of X-ray photoelectron spectroscopy.
2. Mastering measurement technique of X-ray photoelectron spectrometer.
3. Mastering Analysis of XPS spectra.

[Requirements]

Understanding the fundamental of ultrahigh vacuum and electron spectroscopy techniques.

[Evaluation]

brief examination & homework: 50%
practice skill : 50%

[Textbooks]

[References]

[Schedule]

1. Purpose of measurement
2. Principle of XPS measurement
3. Principle of XPS analyzer
4. Maintenance of XPS
5. Operation of XPS equipment (sample preparation,)
6. Operation of sputter depth profiling.
7. Data analysis I (Qualitative analysis)
8. Data analysis II (Quantitative analysis)
9. Summary

*1 You should get 1 credit for this class to use XPS.
**2 If you have already gotten 1 credit for this class in undergraduate, you do not take this class.

[Title]			[Instructor]		
Advanced Instrumental Analysis IG			Tsutomu Muranaka		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
320110G GTI507	1	For All Programs of “Division of Engineering”	Intensive	／	Japanese

[Outline and purpose]

Liquid nitrogen is nitrogen in a liquid state at an extremely low temperature (< 77K). The extreme cold of liquid nitrogen makes handling it very dangerous because it can cause very serious burns that irreparably destroy skin or eyes. Professionals who use it must undergo training to properly learn about its reactivity and thus take appropriate precautions. Liquid nitrogen is stored, shipped and handled in several types of containers, depending upon the quantity required by the user.

After understanding the feature of liquid nitrogen and associated hazards, the safe handling of liquid nitrogen (and container) is shown.

[Objectives]

1. Understanding feature of liquid nitrogen and associated hazards
2. Safe handling of liquid nitrogen and equipment
3. Transferring liquid nitrogen from primary container

[Requirements]

Basic understanding of chemistry and physics

[Evaluation]

brief examination & homework: 50%
practice skill : 50%

[Textbooks]

[References]

[Schedule]

01. User guidance of “Center for Instrumental Analysis”
02. Outline and purpose
03. Characteristics of liquid nitrogen and associated hazards
04. Handling liquid nitrogen and containers
05. Transferring liquid nitrogen from primary container (Lecture)
06. Transferring liquid nitrogen from primary container (Training)
07. Summary

*1 You should get 1 credit for this class to use liquid nitrogen.
**2 If you have already gotten 1 credit for this class in undergraduate, you do not take this class.

[Title]			[Instructor]		
Advanced Instrumental Analysis IIC			Tetsuo Kuwabara/ Susumu Kokubo / Masayo Katsumata		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
320111C GTI510	1	For All Programs of “Division of Engineering”	Intensive	／	Japanese

[Outline and purpose]

Nuclear magnetic resonance spectrometry (NMR) is a typical analytical technique for structural analysis of organic compounds. It determines the physical and chemical properties of atom or molecules. The principle, feature and practical analytical technique of NMR are lectured and trained in this lecture.

[Objectives]

1. Understanding principle and feature of NMR
2. Training analytical technique of NMR
3. Understanding principle and feature of NMR
4. Training analytical technique of NMR

[Requirements]

Basic knowledge of organic compounds and NMR spectroscopy

[Evaluation]

Participation in class 50%
Practice skill：50%

[Textbooks]

None

[References]

None

[Schedule]

1. Principle of NMR
2. Instrumentation of NMR
3. Analytical procedure of NMR
4. Sample preparation, operation and data analysis of NMR
5. Principle of NMR
6. Instrumentation of NMR
7. Analytical procedure of NMR
8. Sample preparation, operation and data analysis of NMR
9. Applications
10. Summary

[Title]			[Instructor]		
Advanced Instrumental Analysis IIIA			Masashi Hisamoto / Makoto Obata		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
320112A GTI511	1	For All Programs of “Division of Engineering”	Intensive	／	Japanese

[Outline and purpose]

The purpose of this course is to learn the principles and practical methods of LC-MS, elemental analysis (carbon, hydrogen, and nitrogen), and polarimetry. Students must take at least one analytical technique from each lecture.

[Objectives]

To learn and understand data analysis methods used in LC-MS, elemental analysis, and polarimetry

[Requirements]

Good understanding of basic organic chemistry is required in all courses
Basic understandings of liquid and gas chromatography are beneficial in LC-MS and elemental analysis courses, respectively.

[Basis of Evaluation]

Reports (30%)
Practical Exam (70%)

[Textbooks]

Title: 役に立つ有機微量元素分析
Author: (社)日本分析学会 有機微量分析研究懇談会
Publisher: みみずく舎
ISBN: 978-4-87211-905-3

[References]

Not specified

[Schedule]

1. Guidance
2. Principles of measurement
3. Principles of instrumentation
4. Maintenance and inspection of equipment
5. Instrumental measurement 1
6. Instrumental measurement 2
7. Instrumental measurement 3
8. Data analysis 1
9. Data analysis 2
10. Review

*1 You should take at least one analytical technique course from each lecture to get 1 credit for this class.
**2 If you have already gotten 1 credit for this class in undergraduate, you do not take this class.
***3 If you are going to use LC-MS, elemental analysis or polarimetry facilities, you should take all corresponding courses to get user license.

[Title]			[Instructor]		
Advanced Instrumental Analysis IIIB			Futaba Kazama / Ikuo Ueta		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
320112B GTI512	1	For All Programs of “Division of Engineering”	Intensive	／	English／ Japanese

[Outline and purpose]

Theory and application of GC-MS for analyzing organic compounds.

[Objectives]

1. Understanding principle of GC-MS.
2. Mastering qualitative analysis by GC-MS.

[Requirements]

Understanding principle of gas chromatography

[Evaluation]

Practical Skills Examination: 100%

[Textbooks]

[References]

[Schedule]

1. Object of GC-MS measurement.
2. Principle of GC-MS measurement.
3. Instrumental principle of GC-MS.
4 Maintenance and inspection of GC-MS.
5. Practice (sample preparation).
6. Practice1 (measurement method).
7. Practice2 (measurement method).
8. Data analysis (basic).
9. Data analysis (application).
10. Summary.

*1 You should get 1 credit for this class to use GC-MS.

[Title]			[Instructor]		
Advanced Instrumental Analysis IIIC			Susumu Kawakubo / Yasutada Suzuki / Masayo Katsumata		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
320112C GTI513	1	For All Programs of “Division of Engineering”	Intensive	／	Japanese

[Outline and purpose]

X-ray fluorescence Spectrometry (XRFS) and inductively-coupled plasma atomic emission spectrometry (ICP-AES) are typical analytical methods for elemental analysis for solid and liquid samples, respectively. The principle, feature and practical analytical technique of XRFS and ICP-AES are lectured and trained in this lecture.

[Objectives]

1. Understanding principle and feature of XRFS
2. Training analytical technique of XRFS
3. Understanding principle and feature of ICP-AES
4. Training analytical technique of ICP-AES

[Requirements]

Basic knowledge of X-ray fluorescence and emission spectroscopy

[Evaluation]

report or midterm examination：40%
practice skill：60%

[Textbooks]

None

[References]

None

[Schedule]

1. Principle of XRFS
2. Instrumentation of XRFS
3. Analytical procedure of XRFS
4. Sample preparation, operation and data analysis of XRFS
5. Principle of ICP-AES
6. Instrumentation of ICP-AES
7. Analytical procedure of ICP-AES
8. Sample preparation, operation and data analysis of ICP-AES
9. Applications
10. Summary

[Title]			[Instructor]		
Advanced Instrumental Analysis IIID（Infrared spectrometry）			Makoto　Obata		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
320112D GTI514	1	For All Programs of “Division of Engineering”	Intensive	／	Japanese

[Outline and purpose]

Measurement of chemicals by Fourier transform Infrared spectrometry (FTIR)

[Objectives]

1. To understand the principle Infrared spectrometry
2. Be familiar with aspect of FTIR operation

[Requirements]

A grounding in Infrared spectrometry

[Evaluation]

Participation in lecture class (30%)
Practice skill(70%)

[Textbooks]

[References]

G.D.Christian,　Analytical Chemistry(6 th Ed)
Ⅱ　Instrumental Analysis (Japanese TR), Maruzen

[Schedule]

1. Object of IR measurement
2. Principle of IR measurement
3. Principle of FTIR instrument
4. Check and maintenance of FTIR instrument
5. Method of measurement 1 (sample preparation and practice)
6. Method of measurement 2(sample preparation and practice)
7. Method of measurement 3(sample preparation and practice)
8. Basic data analysis
9. Advanced data analysis
10. Summary

[Title]			[Instructor]		
Advanced Instrumental Analysis IIIE			Tetsuya Sato / Keisuke Arimoto		
[Code]	[Credits]	[Program]	[Semester]	[Hours]	[Language of instruction]
320112E GTI515	1	For All Programs of “Division of Engineering”	Intensive	／	Japanese

[Outline and purpose]

Laser Raman Scattering Spectroscopy (LRSS) is used to characterize materials and crystallographic orientation of a sample. LRSS offers several advantages for microscopic analysis. Since it is a scattering technique, specimens do not need to be fixed or sectioned. Raman spectra can be collected from a very small volume (< 1 μm in diameter); these spectra allow the identification of species present in that volume.

After understanding the principle and measurement technique of LRSS, qualitative analysis and quantitative analysis is acquired.

[Objectives]

1. Understanding principle and feature of LRSS
2. Mastering measurement technique of LRSS
3. Mastering measurement technique of LRSS qualitative analysis
4. Mastering measurement technique of LRSS quantitative analysis

[Requirements]

Understanding the fundamental of Raman effect, laser, light scattering.

[Evaluation]

brief examination & homework: 50%
practice skill : 50%

[Textbooks]

[References]

[Schedule]

1. Purpose of measurement
2. Principle of LRSS measurement
3. Principle of LRSS analyzer
4. Maintenance of LRSS
5. Operation of LRSS equipment (sample preparation,)
6. Operation of LRSS qualitative analysis
7. Operation of LRSS quantitative analysis
8. Data analysis I (basic)
9. Data analysis II (application)
10. Summary

*1 You should get 1 credit for this class to use LRSS.
**2 If you have already gotten 1 credit for this class in undergraduate, you do not take this class.