

## Course schedules for foreign students staying for six weeks

(Units are calculated for six weeks) \* When one class (1.5 hours per week) is taken in one term (16 weeks), 2 units are obtained.

Students can take one of two courses for 7 credits: an Organic/Physical Chemistry course or an Inorganic/Analytical Chemistry and Chemical Biology course.

### Organic/Physical Chemistry:

<b>I</b>	<b>Cb111</b>	<b>Experimental Organic Chemistry</b>	<b>9 hours per week</b>	<b>(2 credits)</b>
<b>II</b>	<b>Cb131</b>	<b>Experimental Physical Chemistry</b>	<b>9 hours per week</b>	<b>(2 credits)</b>
<b>III</b>	<b>Cb311</b>	<b>Discussions in Chemical Research I</b>	<b>8 hours per week</b>	<b>(3 credits)</b>

#### I. Course Syllabus of Experimental Organic Chemistry (Cb111)

Aim of the course: To obtain the ability of experimental procedure by performing the experiments in organic chemistry, and understand the organic chemistry courses more intensively.

Textbook: Printed textbook is supplied (made by Gunma University faculty).

When the experiment is finished, students must show their notebook to the Professor and answer several questions. Within a week after each experiment, students have to submit an experimental report.

##### Course Schedule

1st week: Guidance. General cautions and manners for experiments are explained. Check all the supplied equipment and resupply if necessary. Also it is explained how to write experimental notebooks and reports.

2nd week: Basic procedure: The technique of recrystallization, TLC, column chromatography

Experiments:

- (1) Parsley extract is analyzed by TLC.
- (2) 2,3-Diphenylpropionitrile is purified by recrystallization. TLC spots are compared before and after purification.
- (3) Parsley extract is separated by column chromatography.

3rd week: Identification of organic compounds

Experiments:

- (1) Identification of aromatic hydrocarbons: Naphthalene picrate is prepared and melting point is measured.
- (2) Identification of amines: Pyridine picrate and quinoline picrate are prepared and purified by recrystallization. Several N-acetamides are prepared and identified by melting points
- (3) Identification of carbonyl compounds: By formation of 2,4-dinitrophenylhydrazones, several aldehydes and ketones are identified.
- (4) Identification of phenols: Preparation of phenol benzoates (Schotten-Baumann reaction)
- (5) Separation of primary and secondary amines by Hinsberg reaction

4th week: Luminol synthesis

Experiments:

5-Amino-2,3-dihydro-1,4-phthalazinedione (luminol) is prepared from 3-nitrophthalic acid and hydrazine.

5th week: Knoevenagel condensation and reduction

Experiments:

- (1) 2,3-Diphenylpropenenitrile is prepared from benzaldehyde and benzyl cyanide.
- (2) 2,3-Diphenylpropanenitrile is prepared by the reduction of diphenylpropenenitrile with  $\text{NaBH}_4$ .

6th week: Summary

#### II. Course Syllabus of Experimental Physical Chemistry (Cb131)

Aim of the course: To obtain the ability of experimental procedure by performing the experiments in physical chemistry, and understand the physical chemistry courses more intensively.

Textbook: Printed textbook is supplied (made by Gunma University faculty).

When the experiment is finished, students must show their notebook to the Professor and answer several questions. Within a week after each experiment, students have to submit an experimental report.

##### Course Schedule

1st week: Guidance. General cautions and manners for experiments are explained. Check all the supplied equipment and resupply if necessary. Also it is explained how to write experimental notebooks and reports.

2nd week: Heat capacity ratios for gases

3rd week: Rate of chemical reaction and activation energy

4th week: Excited state and emission spectroscopy

5th week: Infrared spectroscopy

6th week: Summary

### III. Course Syllabus of Organic Chemistry Laboratory Intensive Short Course (Cb311)

Aims of the course: By arrangement with members of the faculty, each student is assigned to the laboratory and directed in research in organic chemistry. Before taking this course, students must take an interview by the Professor to whom they want to apply. By the students' experience, ability, and knowledge, the research theme is carefully selected and experiments are carried out.

Possible field in organic chemistry:

- Organic Synthesis
- Organic Reactions
- Organosilicon Chemistry
- Organic Structural Chemistry
- Organic Element Chemistry

Course Schedule

1st week: Discussion with the Professor. Research topic is presented and the aim, experiments, and scope are explained.

2nd week: Joining to the laboratory. With a help of graduate students, management of chemicals, equipment, solvents, and reaction procedures are shown.

3rd~5th week: Experiments. Preparations of the target materials, purification, spectroscopic measurement, and identification are performed.

6th week: Summary. The research results are summarized and a detailed report is prepared.

The discussion with Professors can be possible any time. The research results are presented once in three weeks in the group meeting, and discussed in detail. In addition, the students can attend the group meeting held once every week.

## Inorganic/Analytical Chemistry and Chemical Biology:

I	Cb121	Experimental Inorganic/Analytical Chemistry	9 hours per week	(2 credits)
II	Cb141	Experimental Chemical Biology	9 hours per week	(2 credits)
III	Cb313, Cb314	Discussions in Chemical Research II	8 hours per week	(3 credits)

### I. Course Syllabus of Experimental Inorganic/Analytical Chemistry (Cb121)

Aim of the course: To obtain the ability of experimental procedure by performing the experiments in inorganic and analytical chemistry, and understand the inorganic/analytical chemistry courses more intensively.

Textbook: Printed textbook is supplied (made by Gunma University faculty).

When the experiment is finished, students must show their notebook to the Professor and answer several questions. Within a week after each experiment, students have to submit an experimental report.

#### Course Schedule

1st week: Guidance. General cautions and manners for experiments are explained. Check all the supplied equipment and resupply if necessary. Also it is explained how to write experimental notebooks and reports.

2nd week: Chelatometric titration of calcium and magnesium ions in water with EDTA

Experiments:

- (1) Preparation of an EDTA solution.
- (2) Preparation of a primary standard solution of zinc ions.
- (3) Standardization of an EDTA solution.
- (4) Titration of tap water, pond water, river water, and mineral water with an EDTA solution to analyze total amount of calcium and magnesium ions.
- (5) Determination of the total water hardness in ppm of calcium carbonate.

3rd week: Qualitative inorganic analysis

Experiments:

- (1) Separation and detection of 3rd analytical group of cations ( $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ , and  $\text{Cr}^{3+}$ ) by specific reactions.
- (2) Separation and detection of 4th analytical group of cations ( $\text{Ni}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Zn}^{2+}$ , and  $\text{Mn}^{2+}$ ) by specific reactions.

4th week: Observation of oxidation/reduction reaction and evaluation of electromotive force and heat of reaction

Experiments:

- (1) Evaluation of the heat (reaction enthalpy change,  $\Delta H$ ) of the reaction of Zn metal powder with  $\text{Cu}^{2+}$  ion
- (2) Evaluation of the electromotive force (Gibbs free energy change,  $\Delta G$ ) of Daniell cell ( $\text{Zn} | \text{ZnSO}_4(\text{aq}) || \text{CuSO}_4(\text{aq}) | \text{Cu}$ ) and comparison between  $\Delta H$  and  $\Delta G$

5th week: Synthesis of copper (II) sulfate pentahydrate, thermogravimetry, and absorption spectrophotometry

Experiments:

- (1) Copper (II) sulfate pentahydrate is prepared from copper (II) oxide and sulfuric acid.
- (2) Thermogravimetry of copper (II) sulfate pentahydrate is carried out.
- (3) Aqueous solution of tetraammine copper (II) complex is prepared from copper (II) sulfate pentahydrate. The absorption spectra of the solution are measured.

6th week: Summary

### II. Course Syllabus of Experimental Chemical Biology (Cb141)

Aim of the course: To obtain the ability of experimental procedure by performing the experiments in chemical biology, and understand the chemical biology courses more intensively.

Textbook: Printed textbook is supplied (made by Gunma University faculty).

When the experiment is finished, students must show their notebook to the Professor and answer several questions. Within a week after each experiment, students have to submit an experimental report.

#### Course Schedule

1st week: Guidance. General cautions and manners for experiments are explained. Check all the supplied equipment and resupply if necessary. Also it is explained how to write experimental notebooks and reports.

2nd week: Determination of proteins

3rd week: Expression of recombinant proteins

4th week: Chromatographic separation of proteins

5th week: Analysis of enzyme kinetics

6th week: Summary

### III. Course Syllabus of Inorganic/Analytical Chemistry and Chemical Biology Laboratory Intensive Short Course (Cb313 or Cb314).

Aims of the course: By arrangement with members of the faculty, each student is assigned to the laboratory and directed in research in inorganic/analytical chemistry or in chemical biology. Before taking this course, students must take an interview by the Professor to whom they want to apply. By the students' experience, ability, and knowledge, the research theme is carefully selected and experiments are carried out.

Possible field in inorganic/analytical chemistry (Cb313):

- Organometallic Chemistry
- Inorganic Carbon Chemistry
- Inorganic Materials Chemistry
- Inorganic Catalytic Chemistry
- Analytical Chemistry

Course Schedule

1st week: Discussion with the Professor. Research topic is presented and the aim, experiments, and scope are explained.

2nd week: Joining to the laboratory. With a help of graduate students, management of chemicals, equipment, solvents, and reaction procedures are shown.

3rd~5th week: Experiments. Preparations of the target materials, purification, spectroscopic measurement, and identification are performed.

6th week: Summary. The research results are summarized and make a detailed report.

The discussion with Professors can be possible any time. The research results are presented once in three weeks in the group meeting, and discussed in detail. In addition, the students can attend the group meeting held once every week.

Possible field in chemical biology (Cb314):

- Structural biology (protein, phage)
- Protein biosynthesis
- Peptides (medical application)
- Nucleic acids (antisense RNA, aptamer, fluorescent probe)
- Glycoconjugates (synthesis, function)
- Biomembranes (structure, dynamics)
- Receptors (GPCR, nuclear)

Course Schedule

1st week: Discussion with the Professor. Research topic is presented and the aim, experiments, and scope are explained.

2nd week: Joining to the laboratory. With a help of graduate students, management of reagents, equipment, and experimental procedures are shown.

3rd~5th week: Experiments. Samples (chemical, biochemical, or biological) are prepared, followed by their characterizations (biochemical, biophysical, or biological).

6th week: Summary. The research results are summarized and make a detailed report.

The discussion with Professors can be possible any time. The research results are presented once in three weeks in the group meeting, and discussed in detail. In addition, the students can attend the group meeting held once every week.