

## **◆Department of International Development Engineering [International Graduate Program (Master/Doctor)]**

### **1. Program Outline**

The goal of the education in the department is to produce the engineers who can take the leadership in the sustainable development of the global society by utilizing the science and technology. The areas of their contributions include the industry, public works, information and communication technologies, and environment. Toward this goal, several unique components are integrated into the course: first, skills on project formulation and management are emphasized. In addition to the case method, the ongoing international development projects are used as the course materials for the analyses of the problems and their solutions. The skills provide the vision of the high level “problem solution” to the engineering students. Second, advanced knowledge in engineering fields is provided with the focus on the sustainable development. Third, internship and field work are provided as an elective course. Fourth, thesis writing provides an opportunity for the training to build the capacity as the engineer. The searching for solution for a specific development problem is emphasized in addition to technology itself. Therefore, a co-advisor from different engineering fields may be appointed on request.

### **2. Faculty**

#### **Professors:**

OTSUKI, Nobuaki, D. Eng.	Construction Materials
HINODE, Hirofumi, D. Eng.	Inorganic Materials and Properties, Catalyst and Chemical, Process, Chemical Engineering in General
TAKADA Jun-ichi, D. Eng.	Wireless Communications, ICT and Development
KANDA, Manabu, D. Eng.	Regional Atmospheric Environment
TAKAHASHI, Kunio, D. Eng.	Mechanics, Welding and Joining, Tribology, Energy Harvesting
NAKASAKI, Kiyohiko, D. Eng.	Environmental Bioengineering
YAMAGUCHI Shinobu, Ph. D.	Education and IT, International Development and Cooperation, Sustainable Development of World Cultural Heritage

#### **Associate Professors:**

ABE Naoya, Ph. D.	Environmental Information, Policy and Management, Applied Economics, International Cooperation
HANAOKA Shinya, D. Info. Sci.	Transport Planning, Logistics, Transport Project Management
YAMASHITA, Yukihiko, D. Eng.	Computer Science, Intelligent Informatics
TAKAGI, Hiroshi, D. Eng.	Disaster Prevention Engineering, Coastal Engineering
AKITA, Daisuke, D.Eng.	Fluid Dynamics, Aero-space Engineering
EGASHIRA, Ryuichi, D. Eng.	Separation Engineering, Separation Process, Separation Operation

### **3. Guide to Study**

#### **[Master's degree]**

#### **Skills Students Will Learn**

In this program, students will acquire the following skills:

- I. Ability to define problems through enhanced specialized academic skills
- II. Ability to think logically based on a wide range of specialized academic skills
- III. Practical problem-solving skills to ethically conduct creative research and technology development
- IV. Ability to understand and systematize the latest trend in the research field
- V. Communication skills necessary for international success
- VI. Practical skills of international cooperation to support the execution of international projects

### **Overview of the Education**

The department offers an education with the following purposes in order to allow students to master the above-mentioned skills:

A) Learn technical skills in international development engineering (the skill to master I):

Promote an understanding of tools and methodologies for solving problems and develop the ability to define problems through developing specialized core academic skills in international development engineering and offering hands-on education involving practices and exercises.

B) Learn specialized academic skills in a wide range of fields related to international development engineering (the skill to master II)

Develop specialized academic skills in a wide range of fields (e.g., chemical engineering, mechanical engineering, electrical and information engineering, civil engineering, economics, etc.) rather than in one specialized field.

C) Develop the ability to independently define and solve problems (the skill to master III)

Strive to develop and improve practical problem-solving skills in order to solve problems while considering the engineering ethics.

D) Develop the ability to understand and systematize the latest trend in the research field (the skills to master I and IV)

Develop research capabilities to help systematize studies conducive to the development of a specialized field in addition to understanding the positioning and contribution of one's own studies as well as the latest research trend in the field.

E) Develop practical international communication skills (the skill to master V)

Cultivate communication skills through the mixed educational environment in laboratories that includes both Japanese and foreign students. In addition, by conducting lectures in English, develop the ability to explain one's own specialized field logically and systematically in English.

F) Develop practical skills for international cooperation (the skill to master VI)

Develop an understanding of an ideal international cooperation through the mixed educational environment in laboratories that includes both Japanese and foreign students as well as through the lectures based on real-life examples of international project implementation. Furthermore, develop practical skills for international cooperation through practical training such as an international internship.

### **[Doctoral degree]**

#### **Skills Students Will Learn**

In this program, students will acquire the following skills:

- (1) Ability to demonstrate the leadership skills in an international framework
- (2) Ability to create and communicate new insights based on a wide range of systemized deep knowledge from a global perspective
- (3) Ability to recognize the essence and universality of matters and identify and explore new challenges
- (4) Ability to lead in the knowledge frontier based on deep insights and ethics
- (5) Ability to manage a wide range of knowledge in fields such as humanities and social sciences by recognizing their interconnectivity and building upon the field of science and engineering

### **Overview of the Education**

The department offers an education with the following purposes in order for the students to master the above-mentioned skills:

A) Advanced technical knowledge and a wide range of expertise in science and engineering (the skills to master (2) and (3))

Develop the ability to understand the multi-layered academic elements in the field of international development engineering and its connection to each supporting specialized field

B) Ability to lead within the interdisciplinary area (the skills to master (2) and (3))

Develop intuitions and abilities to examine the originality of researches, master languages, and give extensive presentations in international settings, as well as to understand the international research trend.

C) Doctoral dissertation research (the skills to master (2) and (4))

In order for the students to become capable of developing their own world-class research, the program requires doctoral dissertation research. The students will master practical methodologies to identify, define, and solve issues through discussions with the instructor and mentor.

D) Onsite research project (the skills to master (1) and (5))

The students will complete an onsite research project conducted at an organization such as domestic and international companies and research institution in order to master methods to logically develop an argument not only in Japanese but also in languages other than Japanese, such as English, and further develop leadership skills.

#### 4. Graduation Requirements

To acquire the degrees, students in the Department of International Development Engineering must satisfy several requirements as follows.

##### [Master's degree]

For a Master's degree a student must take 30 credits or more and meet other requirements as follows:

- Research Courses(研究科目群): 14 credits or more
  - (1) 8 credits from the Seminar Courses(講究科目)\*.
  - (2) 6 credits or more from the Graduate Research Courses(研究関連科目)+.
- Courses by Departments(専門科目群): 12 credits or more
  - (1) 10 credits or more from the Departmental Courses(専攻専門科目)#.  
(If the student takes more than 6 credits from the Graduate Research Courses+, the student may just take more than 16 credits in total from the Graduate Research Courses+ and the Departmental Courses# instead.)
  - (2) 2 credits or more from the Courses in Other Departments. (他専攻科目)  
(If the student takes more than 2 credits from the Liberal Arts and General Education (G), the student may just take more than 4 credits in total from the Courses in Other Departments and the Liberal Arts and General Education(G))
- 2 credits or more from the Liberal Arts and General Education (G). (大学院教養・共通科目群)
- To submit the master thesis and pass the final examination.

The student is required to study for two years and to get 30 credits or more to complete the Master course. One 2-credit course consists of fifteen 90-minutes lectures including examination. In addition to 30 credits, the student can take the Minor certificate by getting 8 credits provided in a single department. Supervisors advise students for their course works, considering the background of individual students.

##### [Doctoral degree]

For a Doctoral degree a student must meet the following requirements:

1. The seminar course must be taken in each semester during the enrollment (up to third year).
2. 4 credits are required from Courses in Academic Leader Program (ALP) or Productive Leader Program (PLP).
3. Doctoral thesis research, comprised of planning, design, evaluation, improvement etc., should be completed.
4. External activities, such as presentations in international conferences and publications in academic journals, are conducted.
5. The student should pass mid-term evaluations, thesis evaluation and final examination.

## 5. Table of Course Subjects

++: Compulsory Course for Master Students

+: Graduate Research Courses(研究関連科目)

#: Departmental Courses(専攻専門科目)

\*: Seminar Courses(講究科目)

Course Number	Subject	Lecturers	Credits	Semester S: Spring A: Autumn
70001	+Principles of International Development Project	Hanaoka et al.	2	S
70037	++International Development Projects - Case Method	Takada/ Yamaguchi	2	A
70019	+Sustainable Development and Integrated Management Approach	Takada/ Yamaguchi	2	S
70002	+Environmental Engineering in International Development	Hinode/Sasaki/Kanda	2	A
70005	+Principles of International Co-existence	Hinode	2	S
70029	+Introduction to Economics for Engineers	Abe	2	S
70030	+Project Evaluation for Sustainable Infrastructure	Hanaoka	2	S
70041	+Utilization of Resources and Wastes for Environment	Otsuki/Nakasaka/ Egashira	2	A
70042	+Mathematics and Statistics for International Development Eng.	Yamashita	2	A
70006	+International Development Engineering Fieldwork A	Department Chair	1	S
70018	+International Development Engineering Fieldwork B	Department Chair	1	A
70009	#Regional Atmospheric Environment	Kanda	1	A
70043	#Advanced Concrete Technology	Otsuki	2	A
70044	#Coastal Disaster Mitigation	Takagi	2	S
70020	#Rural Telecommunications	Takada/ Aoyagi	2	A
70031	#Welding and Joining Technology	Takahashi	2	S
70032	#Perspective Understanding of Various Kinds of Material	Takahashi	2	A
70014	#Chemical Process for Development	Egashira	1	A
70502	International Development Engineering Off-Campus Project II	Department Chair	4	A
70501	International Development Engineering Off-Campus Project I	Department Chair	4	S
70702	*Seminar in International Development Engineering II	Supervisor	2 (M1)	A
70701	*Seminar in International Development Engineering I	Supervisor	2 (M1)	S
70704	*Seminar in International Development Engineering IV	Supervisor	2 (M2)	A
70703	*Seminar in International Development Engineering III	Supervisor	2 (M2)	S
70802	*Seminar in International Development Engineering VI	Supervisor	2 (D1)	A
70801	*Seminar in International Development Engineering V	Supervisor	2 (D1)	S
70804	*Seminar in International Development Engineering VIII	Supervisor	2 (D2)	A
70803	*Seminar in International Development Engineering VII	Supervisor	2 (D2)	S
70806	*Seminar in International Development Engineering X	Supervisor	2 (D3)	A
70805	*Seminar in International Development Engineering IX	Supervisor	2 (D3)	S

### Liberal Arts and General Education (大学院教養・共通科目群)

International Communication (大学院国際コミュニケーション科目)

Interdisciplinary Courses (大学院総合科目)

Interdepartmental Courses (大学院広域科目)

Arts and Humanities (大学院文明科目)

Career Development Courses (大学院キャリア科目)

Courses for Developing Creativity (大学院創造性育成科目)

Courses for International Students (大学院留学生科目)
---

Courses for Academic Leader Program (ALP)

70006	+International Development Engineering Fieldwork A	Department Chair	1	S
70018	+International Development Engineering Fieldwork B	Department Chair	1	A
70502	International Development Engineering Off-Campus Project II	Department Chair	4	A
70501	International Development Engineering Off-Campus Project I	Department Chair	4	S

ALP Courses offered by Innovator and Inventor Development Platform (IIDP)
---

Courses for Productive Leader Program (PLP)

70006	+International Development Engineering Fieldwork A	Department Chair	1	S
70018	+International Development Engineering Fieldwork B	Department Chair	1	A
70502	International Development Engineering Off-Campus Project II	Department Chair	4	A
70501	International Development Engineering Off-Campus Project I	Department Chair	4	S

PLP Courses offered by Innovator and Inventor Development Platform (IIDP)
---

## 6. Syllabus of Course Subjects

### 70001

#### Principles of International Development Project

Spring Semester (0-2-0)

Assoc. Prof. Shinya Hanaoka, Prof. Nobuaki Otsuki, Prof. Hirofumi Hinode, Prof. Jun-ichi Takada, Prof. Kiyohiko Nakasaki, Prof. Manabu Kanda, Prof. Kunio Takahashi, Prof. Shinobu Yamaguchi, Prof. Masakazu Sasaki, Prof. Keisuke Matsukawa, Prof. Manabu Tsunoda, Assoc. Prof. Ryuichi Egashira, Assoc. Prof. Naoya Abe, Assoc. Prof. Hiroshi Takagi, Assoc. Prof. Yukihiko Yamashita and Dr. Tatsumi Tokunaga

[Aims]

This course aims to introduce the basic procedures and its principles of international development project mainly focusing on developing countries. The course also introduce potential implications of the engineering methods/approaches geared into international development.

[Outline]

Detailed outline will be announced on OCW.

### 70037

#### International Development Projects - Case Method

Autumn Semester (0-2-0)

Prof. Jun-ichi Takada and Prof. Shinobu Yamaguchi

[Aims]

This course aims at introducing practical approaches to development projects. Traditional teaching in the classroom based on lectures and exams, often do not address the need for practical, problem-solving skills. The important and crucial ability for effective project management is the ability to think, analyze, discuss, and develop solutions to problems as professionals may encounter in the field. The case method is an effective approach to strengthening these skills.

[Outline]

1. Introduction to the course
2. Lecture/Discussion: Development & Human Development Indicator

3. Case Method 1: “Ideal and Reality of Project for the Minority People by the Minority People”
4. Lecture/Discussion: Rural Development and Participation Approach
5. Case Method 2: “International Collaboration in Developing Countries”
6. Lecture/Discussion: Rural Development Participation
7. Paper Writing
8. Case Method 3: “Academic Cooperation Program with Thailand”
9. Lecture/Discussion: Risk Management of Technological Change
10. Case Method 4: “Polio Immunizaion in Lang Tang Province”
11. Lecture/Discussion: Community Development
12. Case Method 5: “Run before You Get Shot down?”
13. Group Presentation/Paper Writing

## **70019**

### **Sustainable Development and Integrated Management Approach**

Spring Semester (1-1-0)

Prof. Jun-ichi Takada, and Prof. Shinobu Yamaguchi

[Aims]

This course aims at introducing various approaches to sustainable development. The first half of the course looks at major theories of international development and how they are applied in practical situations. The latter part will take a close look at on-going development projects in selected countries with implication of role of engineering (and engineers). The students are expected to participate in discussion and analyze the project from engineering point of view within the context of “Sustainable Development” Then the course will be followed by the field trip to the development project site, possibly for conducting feasibility studies. The students are responsible to prepare, to contribute, and to express own opinions and ideas. This means, the students’ participation in classroom makes a difference.

[Outline]

1. Introduction to the course
2. Lecture/Discussion: Development vs. Sustainable Development
3. Lecture/Discussion: Development models
4. Group Presentation: Sustainable Development (1)
5. Group Presentation: Sustainable Development (2)
6. Lecture/Discussion: Feasibility Study as a Tool of Sustainable development
7. Lecture/Discussion: Stakeholders Analysis (1)
8. Lecture/Discussion: Stakeholders Analysis (2)
9. Introduction to Development Project (1): “Sustainable use of ICT for improving the quality of primary education in rural Mongolia”
10. Introduction to Development Project (2): “Application of ICT to promote sustainable development of heritage site of Luang Prabang, Lao PDR”
11. In-Class Group Exercises
12. Group Presentation: Stakeholder Analysis
13. In-Class Group Exercises
14. Group Presentation: Mongolia Team
15. Group Presentation: Lao Team

## **70002**

### **Environmental Engineering in International Development**

Autumn Semester (2-0-0) (Odd Years Only)

Prof. Hirofumi Hinode, Prof. Masakazu Sasaki and Prof. Manabu Kanda

[Aims]

This lecture outlines international environmental problems from the engineering side.

[Outline]

1. Introduction
2. Population Growth
3. Air Pollution
  - 1) Acid Rain
  - 2) Ozone Depletion
  - 3) Global Warming
4. Marine Pest
5. Deforestation and Desertification
6. Energy Problem
  - 1) Fossil Fuel Energy and New Energy
  - 2) Energy Saving
7. Waste Management
  - 1) Recycling
  - 2) Eco-business

## **70005**

### **Principles of International Co-existence**

Spring Semester (2-0-0) (Odd Years Only)

Prof. Hirofumi Hinode

[Aims]

Engineers sometimes encounter difficult ethical problems. In order to co-exist with others, we should know about ourselves as well as others. In this lecture, we look into the relationship between others and us in the different levels of individual, races, corporations and nations.

[Outline]

1. Introduction
2. Relationship between Korea and Japan
3. Relationship between China and Japan
4. Humanitarian mind
5. Religion in the U.S.
6. Religion in the Mideast
7. International enterprise
8. Examples of establishing corporation in foreign countries (1)
9. Examples of establishing corporation in foreign countries (2)
10. Examples of establishing corporation in foreign countries (3)
11. Collaboration at the international field
12. Discussion
13. Summary

## **70029**

### **Introduction to Economics for Engineers**

Spring Semester (2-0-0)

Assoc. Prof. Naoya Abe

[Aims]

This course aims to provide basic concepts and theories of microeconomics (and limited parts of macroeconomics) to potential engineering graduate students who have no economics background for their easy (and not complete) access to current economic topics and the fields of applied economics such as environmental economics and development economics.

[Outline]

1. Introduction
2. Consumer theory: preferences, indifference curves and utility function
3. Consumer theory: types of goods and price indices
4. Consumer theory: elasticity, price& income effects
5. Consumer theory: demand curves and measurement of welfare change
6. Producer theory: production function, short-run and long-run, and return-to-scale
7. Producer theory: profit function, cost curves, and supply function
8. Producer theory: monopoly and oligopoly
9. Market mechanism: social surplus, Pareto efficiency and pure exchange
10. Externalities and countermeasures
11. Measurement of national income and other measurements for nation development
12. Input-Output Analysis of an economy
13. Inflation and foreign exchange rates
14. Foreign aid and foreign direct investment

## **70030**

### **Project Evaluation for Sustainable Infrastructure**

Spring Semester (2-0-0)

Assoc. Prof. Shinya Hanaoka

[Aims]

This course aims to provide the methods necessary to undertake project evaluation and cost benefit analysis for sustainable infrastructure. The methods comprise of microeconomics background, cost benefit analysis, valuing market and non-market goods, and other technical issues.

[Outline]

1. Introduction to Project Evaluation
2. Basics of Microeconomic Theory
3. Foundations of Cost Benefit Analysis
4. Valuing Benefits and Costs in Primary Markets
5. Valuing Benefits and Costs in Secondary Markets
6. Discounting Benefit and Costs
7. Existence Value
8. Valuing Impacts from Observed Behavior: Direct Estimation Methods
9. Valuing Impacts from Observed Behavior: Indirect Market Methods
10. Contingent Valuation
11. Cost Effectiveness Analysis
12. Accuracy of Cost Benefit Analysis



## **70041**

### **Utilization of Resources and Wastes for Environment**

Autumn Semester (2-0-0)

Prof. Nobuaki Otsuki, Prof. Kiyohiko Nakasaki and Assoc. Prof. Ryuichi Egashira

[Aims]

In order to achieve “sustainability” in our society, we have maximized resources productivity (product generated per unit resources) in industrial activities and minimized material/energy load (wastes) to the environment. In addition, wastes have been reused and recycled properly, even if wastes are generated. This lecture provides several examples of such industrial processes and technologies as above which effectually utilize resources and wastes.

[Outline]

1. Introduction and fundamental information about waste
2. Activities in construction industries
3. Activities in cement and concrete field (1)
4. Activities in cement and concrete field (2)
5. Bio-refinery (1)
6. Bio-refinery (2)
7. Solid waste treatment (1)
8. Solid waste treatment (2)
9. Cascade biomass use
10. Petroleum refinery (1)
11. Petroleum refinery (2)
12. Petroleum refinery (3)
13. Water treatment
14. Summary

## **70042**

### **Mathematics and Statistics for International Development Engineering**

Autumn Semester (2-0-0)

Assoc. Prof. Yukihiko Yamashita

[Aims]

This course aims at introducing basic mathematics and statistics used in international development engineering in succession to those of undergraduate study. For mathematics, advanced linear algebra and optimization techniques are lectured. For statistics, characterizations of normal distribution, test and estimation are lectured.

[Outline]

1. Introduction and Eigenvalue problem
2. Singular value decomposition
3. Generalized inverses of matrices (Moore-Penrose generalized inverse)
4. Octave (Program for linear algebra calculation)
5. Maximum gradient method
6. Conjugate gradient method
7. Quasi-Newton's method
8. Conditional optimization
9. Support vector machine
10. Probability
11. Normal distribution
12. Estimation and test

13. Cramer-Rao lower bound
14. Statistical learning theory

### **70006/70018**

#### **International Development Engineering Field Work A and B**

A : Spring Semester (0-0-1) / B : Autumn Semester (0-0-1)

Chair, Department of International Development Engineering

[Aims]

Students shall plan and practice the activities related to the international development engineering. Through the experience of these activities, the students can learn the connection between the course works and the real development.

[Outline]

1. Approval of the working plan by supervisor and department head
2. Activities (more than one week)
3. Submission of the report to supervisor and department head
4. Oral presentation of the report

(Examples of activities)

- Internship or training in foreign or domestic companies.
- Internship or working experience in the organizations related to the international development.
- Field study related to the lectures given in the department.
- Review and survey of state-of-art technologies by participating to an international conference. Visit of other research institution to give presentation or to discuss on research topic, by utilizing this occasion.

### **70009**

#### **Regional Atmospheric Environment**

Autumn Semester (1-0-0)

Prof. Manabu Kanda

[Aims and Scope]

The purpose of this lecture is twofold. One is to understand the fundamental knowledge and theoretical concepts of Boundary-Layer Meteorology (BLM). The other is to review the recent applications of BLM to physical urban planning and civil engineering.

[Outline]

1. Basic theory of Atmospheric Boundary Layer
  - 1.1 Definition of Atmospheric Boundary Layer
  - 1.2 Diurnal Change of Atmospheric Boundary Layer
  - 1.3 Constant Flux Layer
  - 1.4 Turbulent Transfer Process
  - 1.5 Radiative Transfer
  - 1.6 Energy Balance of Ground Surface
2. Application to Physical Urban Planning
  - 2.1 Mesoscale Circulation
  - 2.2 Heat Island Phenomena
  - 2.3 Micrometeorology of Forest Canopy
  - 2.4 Micrometeorology of Urban Canopy
  - 2.5 Energy Balance of Human-body
  - 2.6 Numerical Prediction of Urban Climate

## **70043**

### **Advanced Concrete Technology**

Autumn Semester (2-0-0)

Prof. Nobuaki Otsuki

[Aims]

Lectures on the state of the art of concrete technology will be presented, including some topics related to developing countries.

[Outline]

1. Introduction
2. Cementitious materials — past, present and future
3. Structure of hardened concrete
4. Strength
5. Cements (1)
6. Cements (2)
7. Admixtures (1)
8. Admixtures (2)
9. Aggregates
10. Light weight Aggregates
11. Flowable concrete, including anti-washout concrete
12. Pre-stressed concrete
13. Durability
14. Maintenance

## **70044**

### **Coastal Disaster Mitigation**

Spring Semester (2-0-0)

Assoc. Prof. Hiroshi Takagi

[Aims]

Coastal disasters due to such as tsunamis, storm surges, and high waves lead to considerable loss of human life and property. The threat from coastal disasters may exacerbate because of the impact of climate change and economic development that accelerate rapid population increase in coastal areas. This course comprises lectures on basic theories, engineering, and management for mitigating such risks caused by coastal disasters.

[Outline]

1. Introduction
2. Basic of Water Wave Theory
3. Theory of Astronomical Tides
4. Earthquakes and Tsunamis
5. Tropical Cyclones and Storm Surges
6. High Waves
7. Coastal Erosion
8. Earth's Climate System and Climate Change
9. Structures for Coastal Protection
10. Coastal Management and Ecosystem
11. Case studies
12. Oral Presentation

## **70020**

### **Rural Telecommunications**

Autumn Semester (2-0-0)

Prof. Jun-ichi Takada and Assoc. Prof. Takahiro Aoyagi

[Aims]

Information and communication technologies enable the transfer of information instantly between any points in the world. Moreover, it has become common understanding that the ICT infrastructure is indispensable for the development of the industry and economy. However, the reality is very severe in the developing world, especially in rural and remote areas. Imbalance of the distribution of ICT infrastructure in the world has been intolerable for the long time. This lecture overviews the history, technologies and applications of ICT infrastructure in rural and remote areas, both in the social and the technical aspects.

[Outline]

1. Introduction
2. Historical Aspects of Telecommunications 1 - Missing Link -
3. Historical Aspects of Telecommunications 2 - 20 years after Missing Link -
4. Communication technology
5. Information Technology and Internetworking
6. Free and Open Source Software
7. Access Infrastructure 1 - Cellular Systems -
8. Access Infrastructure 2 - Satellite Systems -
9. Access Infrastructure 3 - Wireless Computer Network -
10. Backbone Infrastructure - Optical link, Wireless backhaul, Satellite -
11. E-learning 1 - Overview and Theory
12. E-learning 2 - Instructional Design
13. E-learning 3 - Information and Communication Technology
14. E-learning 4 - Law and Economy
15. E-learning 5 - Case study
16. Case Presentation (in place of final exam)

## **70031**

### **Welding and Joining Technology**

Spring Semester (2-0-0)

Prof. Kunio Takahashi

[Aims]

Welding and joining processes are the key technology in the industry. The processes will be reviewed including recent advanced processes. Phenomena and mechanisms of the processes will be explained based on material science, mechanics, and electrical engineering.

[Outline]

1. History of welding and joining processes
2. Required condition for welding and joining processes
3. Method and its classification
4. Arc welding phenomena
5. Arc welding power sources and equipments
6. Cutting
7. Materials and their behavior in welding and joining
8. Metallurgy of steel and heat treatment

9. Heat input and cooling rate
10. Weld defects
11. Mechanical properties of weld joints
12. Residual stress and weld deformation
13. Weld design

## **70032**

### **Perspective Understanding of Various Kinds of Material**

Autumn Semester (2-0-0)

Prof. Kunio Takahashi

[Aims]

Material properties such as latent heat, electric conductance, diffusion coefficient, elasticity, strength, etc... will be explained for variety of materials such as metals, ceramics, semiconductors, concretes, composites, etc... from the universal view point using bases of quantum mechanics, statistical mechanics, thermo-dynamics, etc...

[Outline]

1. Physics for an universal feature of materials
2. Electric properties of materials
3. Mechanical properties of materials
4. Thermal properties of materials
5. Chemical properties of materials
6. Metals
7. Insulators
8. Semi-conductors
9. Ceramics
10. Carbon steels
11. Concrete

## **70014**

### **Chemical Process for Development**

Autumn Semester (1-0-0)

Assoc. Prof. Ryuichi Egashira

[Aims]

The viable applications of chemical unit process or operation for development are introduced through relatively new examples related to waste, water treatments, and energy.

[Outline]

1. Introduction
2. View of Chemical Process for Development
3. Waste Treatment - Process for Management of Solid Waste in Developing Regions
4. Water Treatment - Decolorization of Wastewater from Sugarcane Factory
5. Water Treatment - Removal and Recovery of Metals, Organic Compounds, etc. from Water Using Liquid Phase Equilibrium
6. Energy - GTL (gas-to-liquid): Chemical Liquefaction of Natural Gas
7. Energy - Biofuel Process

**70702****Seminar in International Development Engineering II**

Autumn Semester (0-2-0) [Master Course First Year]

Supervisor

[Aims and Scope]

Each student is instructed to participate in presentations and workshops in the Department, or seminars, special lectures and conferences out of the Department in order to acquire the basic knowledge, experimental techniques, and analytical methods in her/his own research area, and to produce a summary report of participated events.

**70701****Seminar in International Development Engineering I**

Spring Semester (0-2-0) [Master Course First Year]

Supervisor

[Aims and Scope]

Each student is instructed to participate in presentations and workshops in the Department, or seminars, special lectures and conferences out of our the Department in order to grasp research trend and state of the art in her/his own research area, and produce a summary report of participated events. In addition, she/he should continue acquiring the basic knowledge and methodologies following Seminar in International Development Engineering II.

**70704****Seminar in International Development Engineering IV**

Autumn Semester (0-2-0) [Master Course Second Year]

Supervisor

[Aims and Scope]

Each student is instructed to conduct an interim poster presentation in the Department in order to understand the methodologies to solve problems in her/his own research, and to improve presentation and communications skills. In addition, she/he should continue acquiring related knowledge and methodologies following Seminars in International Development Engineering I and II.

**70703****Seminar in International Development Engineering III**

Spring Semester (0-2-0) [Master Course Second Year]

Supervisor

[Aims and Scope]

Each student is instructed to complete the master thesis with understanding of the significance and academic/ social contributions of her/his own research and by summarizing backgrounds and issues of related research areas from a broad perspective. She/he should utilize the knowledge and methodologies acquired through Seminars in International Development Engineering I, II and IV.

**70801-70806****Seminar in International Development Engineering V-X**

Spring Semester (V/VII/IX), Autumn Semester (VI/VIII/X) (0-2-0) [Doctoral Course]

Supervisor

[Aims and Scope]

Advanced and high level researches including colloquium, practice and experiment are required.

[Important]

Following the education reform in April 2016, in principle, new courses equivalent to those currently available will be offered.

Regarding the newly offered courses, please check the cross-reference table that will be available on Tokyo Tech's website at a later date.