

# **Interdisciplinary Education Program on Advanced Human Resource Education Program for Emerging Materials Innovations to Solve Social Issues**

## **1. IGP (A) Outline**

The program for “Advanced Human Resource Education Program for Emerging Materials Innovations to Solve Social Issues” (eMAT-SOC) aims to train highly educated engineers who have both data science knowledge and materials research/development capabilities to achieve Sustainable Development Goals (SDGs). The Program graduates will have a wide spectrum of technical knowledge ranging from fundamentals to applications in the fields of advanced materials and chemical technology of the Graduate Major they belong to. In addition to coursework, they will gain extensive knowledge and experience in Japanese companies' globalization, data science and materials research and development, and group work skills. They are expected to take roles as leaders in international projects, such as overseas deployments by Japanese companies or development projects by international organizations, and show a high degree of creativity and innovative thinking in their respective fields. eMAT-SOC consists of six Graduate Majors in fundamental engineering disciplines aiming at SDGs. The students will be enrolled in one of the Graduate Major and educated under the Integrated Doctoral Education Program, in which they are expected to study from Master's to Doctoral programs continuously to obtain both degrees. Outlines of each Graduate Major are given below.

### **1. Graduate Major in Materials Science and Engineering:**

Major of Materials Science and Engineering aims at nurturing research scientists and engineers who have deep insight into materials properties and function, and the ability to develop highly innovative materials. The education is aimed towards developing creative and practical minds, in addition to nurturing excellent understanding of social problems and modern society requirements. Through the advanced educational system, the students are expected to thrive in the global competence to contribute towards human welfare and sustainability.

### **2. Graduate Major in Chemical Science and Engineering:**

Major in Chemical Science and Engineering aims at fostering human resources, who have basic academic skills and logical thinking ability in chemical science and engineering and related fields, and can contribute to developing environmentally-benign society by applying their science and engineering wisdom. The program aims at training international engineers and leading scientists who can understand the relationship between “Science and Technology”, “Industrials”, and “Environment”, acquire advanced expert knowledge in chemistry, well-rounded accomplishment, and international communication skills.

### **3. Graduate Major in Energy Science and Informatics:**

This program takes a holistic approach to graduate education in the Interdisciplinary field of Energy Science and Informatics. It aims to develop individuals highly specialized in physics, chemistry, materials science, mechanical engineering, electrical engineering, or information science, capable of solving energy problems based on information science from a multidimensional energy theory perspective. The Program teaches students highly technical knowledge based on fundamental disciplines. In addition, this major provides students with various skills for discerning the underlying nature and universality of energy/information-related phenomena based on systematized, broad, and deep knowledge in the field and information science skills; set and solve new challenges; and demonstrate global leadership.

### **4. Graduate Major in Human Centered Science and Biomedical Engineering:**

In this major, all research and development of engineering and technology regarding human healthcare, medicine and environment conservation, which has been conducted in each disciplinary field, were defined as “Human Centered Science and Biomedical Engineering” and the education and research to consider the correlation between human characteristics and artifact ones comprehensively are provided as based on the in-depth understanding of people and society. The major's goal is to foster talents who have a deep understanding of human beings by acquiring the knowledge of natural sciences, bioethics, the foundation of health, medical and environmental sciences and also learning several disciplinary fields such as Materials and

Chemical Technology, Mechanical Engineering, Electrical and Electronic Engineering, Information Technology, Life Science & Technology. That means to foster scientists and engineers who can contribute to the development of science & technology to protect people's health and realize a sustainable society.

#### 5. Graduate Major in Nuclear Engineering:

How should nuclear power be used in the future? How can radiation, which is already used for cancer treatments, be used more effectively? In order to answer this question, the Graduate Major in Nuclear Engineering teaches students to systematically learn and conduct research on nuclear engineering, its use, radiation, and the science involved.

#### 6. Earth-Life Science

We will foster students who wish to tackle fundamental questions in natural science such as the origin and evolution of living planets and solve global issues such as the environment, climate, water, and resources that are essential to our long-term survival. The interdisciplinary and international research capabilities of the Earth and Life Science Institute (ELSI) — a World Premiere International Research Center (WPI) — will benefit the education of graduate students.

### **1-1. Graduate Major(s) available to IGP (A) Students**

Graduate Major in Materials Science and Engineering

Graduate Major in Chemical Science and Engineering

Graduate Major in Energy Science and Informatics

Graduate Major in Human Centered Science and Biomedical Engineering

Graduate Major in Nuclear Engineering

Graduate Major in Earth-Life Science

## **2. Competencies Developed**

In this program, students will acquire the following skills:

- Ability to resolve problems using broad engineering knowledge and skills
- Ability to develop a diverse view of things with well-rounded education and engineering ethics
- Ability to see the social trends, and find and solve current problems
- Ability to perform a project with understating of future trends from a global view by collaborating with others
- Ability to have communication and presentation abilities with logical explanation

## **3. Learning Goals**

The goals of student learning as follows:

- A) Fundamental knowledge in the field of advanced materials and chemical technology
- B) Specialized and advanced subjects in the field of advanced materials and chemical technology for SDGs
- C) Interdisciplinary view of science and engineering in international perspective for SDGs
- D) Creative and practical research ability
- E) Logical communication skills

## **4. IGP (A) Completion Requirements and Courses**

### **【For Master's degree】**

#### **【1.】 IGP (A) Completion Requirements**

(1) Credits

a. 4 credits listed in Table M1 must be acquired.

- Modern Japan (2 credits)
- Industrial Design (2 credits)

b. more than 1 credit from restricted elective courses must be acquired.

- Basic Materials Informatics (1 credit)
- Fundamentals of Artificial Intelligence (1 credit)

c. The seminar must be acquired in each semester.

## (2) Thesis

The student must complete a special research, submit a thesis for the degree and take the final examination given after the submission of her/his thesis for the qualification. The students qualified by the examination committee can go onto the Doctoral program with some formalities.

Under this program, in addition to the above-mentioned requirements, students must also fulfill the Graduate Major completion requirements of their departments (degree completion requirements). For completion requirements of your Graduate Major, please refer to the relevant Graduate Major pages in “Guide to Graduate Majors (for IGP)”.

## 【2.】 IGP (A) Courses

**Table M1. Courses of IGP (A)**

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Breadth courses	400 level	LAW.X416	◎		Modern Japan	1-1-0	2,3,4,5	A,B,C,D,E	
		XCO.T489	○		Fundamentals of Artificial Intelligence	1-0-0	1,4,5	A,B,C,D	
		TCM.A401	○		Basic Materials Informatics	1-0-0	3,4,5	A,B,C,D	
		HCB.C404	◎		Industrial Design	1-1-0	1,2,4,5	A,B,C,D,E	

Note :

- ◎ : Required course
- ○ : Restricted elective
- Competencies: 1 = Specialist skills, 2 = Liberal arts skills, 3 = Communication skills, 4 = Applied skills (inquisitive thinking and/or problem-finding skills), 5 = Applied skills (practical and/or problem-solving skills)

## **【For Doctoral degree】**

### **【1.】 IGP (A) Completion Requirements**

- (1) The seminar must be acquired in each semester.
- (2) The candidate must complete and upload a thesis for the degree, and take and pass the final examination and evaluation of his/her thesis.

The candidate who satisfies the above requirements and passes the final examination is awarded a Doctoral degree.

Students who achieve excellent results may have their completion period shortened. The standard period of course completion is five years (two years for the master's course and three years for the doctoral course).

### **【2.】 IGP (A) Courses**

4 credits (0-0-4) of Off-Campus Project of the Graduate Major are recommended.

Under this program, in addition to the above requirements, students must also fulfill the Graduate Major completion requirements of their departments (degree completion requirements). For completion requirements of your Graduate Major, please refer to the relevant Graduate Major pages in “Guide to Graduate Majors (for IGP)”. All students should consult with their own supervisors and program/special course coordinators about the study plan.