Course number	G-ENE20 63170 SE28		
Course title (and course title in English)	Future Energy:Hydrogen Economy Future Energy:Hydrogen Economy	Instructor's name, job title, and department of affiliation	Graduate School of Energy Science Professor,MCLELLAN, Benjamin

Target year	Master's students	Number of credits	2	Year/semesters	2023/First semester
Days and periods	Wed.1	Class style	Lecture	Language of instruction	English

[Overview and purpose of the course]

This course will introduce the concepts and technology of the Hydrogen Economy. The course is intended to give insight into this topical area of research and its potential benefits and impacts.

[Course objectives]

The aim for the class is for students to understand each of the major phases in hydrogen energy infrastructure, and the main technologies considered. Students will learn technical, social, environmental and economic aspects of the systems. Through class discussions and a final report, students will hone their skills in argument and learn to identify critical criteria for technology assessment.

[Course schedule and contents]

The course will consist of lectures on key supporting technologies and system-wide aspects of hydrogen energy systems. The following themes will be discussed (order may change):

1. Introduction
2. Hydrogen sources and limitations
3. Hydrogen production #8211 Carbon fuels
4. Bio-hydrogen production
5. Hydrogen production #8211 Electro / thermo / chemical
6. Assessment: In-class discussion #8211 1
7. Hydrogen storage and distribution
8. Hydrogen utilisation #8211 fuel cells I
9. Hydrogen utilisation #8211 fuel cells II
10. Hydrogen utilisation #8211 engines / turbines / non-fuel
11. Assessment: In-class discussion #8211 2
12. Hydrogen economy safety and society
13. Hydrogen economy economics and resources
14. Hydrogen economy environmental aspects
15. Feedback

[Course requirements]

None

[Evaluation methods and policy]

The following items of assessment are used (shown below). The specific requirements and assessment criteria are distributed in class.

Continue to Future Energy:Hydrogen Economy(2)↓↓↓

Future Energy:Hydrogen Economy(2)

Final report (Technology assessment in a specific country context) [50%]
Class discussion 1 - Hydrogen production (Discussion and handout) [10%]
Class discussion 2 - Hydrogen storage and utilisation (Discussion and handout) [20%]
Small exercises [20%]

Will be evaluated according to the grade evaluation policy of the Graduate School of Energy Science

[Textbooks]

Not used

[References, etc.]

（Reference books）

Introduced during class

[Study outside of class (preparation and review)]

Students will need to spend time researching a specific allocated country`s energy system and determining how to develop an appropriate hydrogen economy. This will be particularly before each class discussion.

（Other information (office hours, etc.)）

Basic knowledge of energy concepts and ability to apply mathematics is required.
Contact may be made via email for out-of-class discussion.

*Please visit KULASIS to find out about office hours.

Course number	G-ENE20 63392 LE28 G-ENE20 63392 LE77		
Course title (and course title in English)	Fusion Energy Science and Technology Fusion Energy Science and Technology	Instructor's name, job title, and department of affiliation	Institute of Advanced Energy Professor,NAGASAKI KAZUNOBU Institute of Advanced Energy Associate Professor,MORISHITA KAZUNORI Institute of Advanced Energy Associate Professor,YAGI JURO Institute of Advanced Energy Associate Professor,KOBAYASHI SHINJI

Target year	Master's students	Number of credits	2	Year/semesters	2023/Second semester
Days and periods	Tue.1	Class style	Lecture	Language of instruction	English

[Overview and purpose of the course]

Subjects on the science and technology of the latest information on the development of fusion energy are offered from viewpoints of energy generation, technology, material and utilization

[Course objectives]

To understand basic knowledge and latest topics on energy generation, conversion, control and utilization of fusion energy from the aspect of technology, materials and application.
To analyze and critically evaluate the energy systems technology on which each students will be studying, and to discuss a strategy of study from social, technical, environmental and sustainability aspects.

[Course schedule and contents]

Latest topics about the development of fusion reactor, its energy conversion systems, and material issues are lectured by 15 times of classes including feed back.
1. Fusion Energy Conversion (Yagi)
(1)Development of Fusion Devices
(2)Fusion Energy Conversion System
(3)Fusion Safety
(4)Energy, environment, and economics

2. Control of fusion energy (Nagasaki)
(5)Ignition condition
(6)Magnetic confinement system
(7)Confinement, transport and stability
(8)Plasma heating

3. Magnetically confined fusion plasma experiments (Kobayashi)
(9) Control of fusion plasmas
(10) Plasma diagnostic
(11) Analytical technique for fusion plasmas

4. Recent Progress in Fusion Structural Materials R&D (Morishita)
(12)Fusion blanket structural materials and their requirements for fusion application
(13)Effects of high energy neutron irradiation
(14)Modeling of radiation damage process in fusion materials

Continue to Fusion Energy Science and Technology(2)↓↓↓

Fusion Energy Science and Technology(2)

(15)Current status of fusion materials R&D

[Course requirements]

None

[Evaluation methods and policy]

Attendance and report(term paper) will be required. Evaluation will be based on the scores of each reports to be given as 100 point maximum.

[Textbooks]

Original materials are provided. Some materials are available on the web with limited access.

[References, etc.]

（Reference books）

to be introduced in the lecture

[Study outside of class (preparation and review)]

Occasional homeworks may be given to consider an energy related topics.

（Other information (office hours, etc.)）

always available upon appointments.

*Please visit KULASIS to find out about office hours.

Course number	G-ENE20 63393 LE77 G-ENE20 63393 LE71 G-ENE20 63393 LE28		
Course title (and course title in English)	Energy Conversion System Design Energy Conversion Systems and Functional Design	Instructor's name, job title, and department of affiliation	Graduate School of Energy Science Professor,IMATANI SHIYOUJI Graduate School of Energy Science Professor,KAWANABE HIROSHI Graduate School of Energy Science Professor,SUMIGAWA TAKASHI Graduate School of Energy Science Professor,Jun HAYASHI

Target year	Master's students	Number of credits	2	Year/semesters	2023/Second semester
Days and periods	Tue.1	Class style	Lecture	Language of instruction	English

[Overview and purpose of the course]

Subjects on the conversion, control and utilization of various kinds of energy from viewpoints of science and engineering are offered.

[Course objectives]

To understand problems, measures and their academic backgrounds in technologies for improving energy conversion efficiencies with greater safety and reliability of energy systems.

[Course schedule and contents]

Some topics on energy conversion systems and functional designs are lectured.

1. Combustion Technology in Thermal Systems(3-4 weeks)
- Application of the combustion technology on industrial furnaces
- Alternative fuel utilization and basic features of combustion
- Muti-phase combustion in the thermal systems

2. Combustion Science and Engineering (3-4 weeks)
- Fundamentals of combustion
- Laser diagnostic techniques
- Numerical simulation of combustion process

3. Mechanical Properties of Nano-/Micro-sized Materials (3-4 weeks)
- Fundamentals of mechanical properties of materials
- Fracture mechanics on nano-scale stress singular field
- Fatigue of micro-sized metals

4. Modeling and Analyses of Solids and Structures (3-4 weeks)
- Elements of continuum mechanics
- Constitutive modeling of complex materials
- Computational mechanics of solids and structures

Courses are provided totally for 14 weeks with 1 week for feedback.

Continue to Energy Conversion System Design(2)↓↓↓

Energy Conversion System Design(2)

[Course requirements]

None

[Evaluation methods and policy]

The evaluation is based on attendance and report. The report subject will be provided by each lecturer. Both the attendance rate and the result of report are important for the final score.

[Textbooks]

Handouts

[References, etc.]

（Reference books）

Introduced during class

[Study outside of class (preparation and review)]

To be announced in class if necessary.

（Other information (office hours, etc.)）

*Please visit KULASIS to find out about office hours.

Course number	G-ENE20 63167 SE17		
Course title (and course title in English)	Energy and SD Energy Systems and Sustainable Development	Instructor's name, job title, and department of affiliation	Graduate School of Energy Science Professor,MCLELLAN, Benjamin

Target year	Master's students	Number of credits	2	Year/semesters	2023/Second semester
Days and periods	Tue.2	Class style	Lecture	Language of instruction	English

[Overview and purpose of the course]

This course will introduce key concepts of sustainable development, and engage students in understanding the interconnections of energy systems in the larger picture of sustainable development. The course finishes with a workshop applying these concepts to energy systems planning.

[Course objectives]

The goals of the course are for students to understand the breadth and complexity of sustainability and its implications for energy systems. Students will learn key concepts and frameworks, and apply critical thinking and team processes to the planning of sustainable energy systems in a given context. Technical, environmental and socio-economic topics and approaches will be covered.

[Course schedule and contents]

The course will consist of lectures and interactive sessions on the following key themes (order to be clarified in first session):

The course will consist of lectures and interactive sessions on the following key themes (order to be clarified in first session):

1. Introduction / Concepts in Sustainability
2. Energy in Lifecycles / Energy Systems
3. Renewable Energy Technologies
4. Non Renewable “Clean” Energy Technologies
5. Natural resource usage and sustainability
6. Emissions, Energy and Sustainability
7. Energy system configurations
8. Transitions and policy
9. Energy and Development
10. Global and local energy sustainability
11. Measuring Sustainability
12. Decision-making in Sustainable Development
13. Energy system design workshop I (12.5%)
14. Energy system design workshop II (12.5%)
15. Feedback

Continue to Energy and SD (2)↓ ↓ ↓

Energy and SD (2)

[Course requirements]

None

[Evaluation methods and policy]

Students will be evaluated on three major elements:
1. Participation in class activities and submission of out-of-class tasks aimed to solidify learning of concepts (40%)
2. Participation in the 2-3 week workshop capping-off the course (30%)
3. Submission of a final report (30%)

Will be evaluated according to the grade evaluation policy of the Graduate School of Energy Science

[Textbooks]

Not used

[References, etc.]

（Reference books）

Suggested reading:
Sustainable Energy: Choosing among options (Tester et al., 2005)
Other reading supplied via PandA

[Study outside of class (preparation and review)]

Students will be required to do occasional out-of-class preparation exercises.
Slides will be provided before the lecture via PandA so that pre-reading can be undertaken.
Other references will be given in class.

（Other information (office hours, etc.)）

Available by appointment.

*Please visit KULASIS to find out about office hours.

Course number	G-ENE20 63118 LE28		
Course title (and course title in English)	Energy Systems Analysis and Design Energy Systems Analysis and Design	Instructor's name, job title, and department of affiliation	Graduate School of Energy Science Associate Professor,OGATA SEIICHI

Target year	Master's students	Number of credits	2	Year/semesters	2023/Second semester
Days and periods	Tue.3	Class style	Lecture	Language of instruction	English

[Overview and purpose of the course]

By Seiichi OGATA, Department of Socio-environmental Energy Science, Graduate School of Energy Science,

The framework and methodology for energy systems analysis and design in a region and/or/ country, especially related to a model-based approach, are introduced. Furthermore, the theories of energy supply-demand systems are discussed. Participants will develop a simple conceptual model by selecting some energy supply-demand systems as a study target.

[Course objectives]

To understand the basic knowledge and the modeling methodologies of Energy supply-demand systems.

[Course schedule and contents]

(1) Statistics of energy supply and demand,
(2) Numerical modeling of energy supply and demand,
(3) What is a system modeling?
(4) Modeling and decision making,
(5) Modeling exercise,
(6) Theoretical approach to energy supply-demand systems,
(7) Liberalization of the energy industry,

[Course requirements]

Nothing

[Evaluation methods and policy]

Discussion about modeling of energy systems and report submission.

[Textbooks]

Instructed during class

[References, etc.]

（Reference books）

Introduced during class

Continue to Energy Systems Analysis and Design (2)↓↓↓

Energy Systems Analysis and Design (2)

[Study outside of class (preparation and review)]

Student will make a conceptual model for the energy supply-demand systems which the student has selected by himself/herself.
The work for conceptual modeling will be an assignment.

（Other information (office hours, etc.)）

*Please visit KULASIS to find out about office hours.

Course number	G-ENE20 63172 LE28		
Course title (and course title in English)	Energy Policy Energy Policy	Instructor's name, job title, and department of affiliation	Institute for Integrated Radiation and Nuclear Science Professor,UNESAKI HIRONOBU

Target year	Master's students	Number of credits	2	Year/semesters	2023/Second semester
Days and periods	Wed.1	Class style	Lecture	Language of instruction	English

[Overview and purpose of the course]

Energy is dispensable for the welfare of humankind and sound development of social activities in the modern society. The stable supply of energy is influenced by circumstances of political issues and technological development. Based on the mid- to long-term forecast of energy supply and demand, various specific issues related to energy policy, including energy resources, environmental issues, trends in major countries, forecasts and predictions, will be discussed in this course.

[Course objectives]

To achieve ability
- to describe various energy resources used in modern society from both natural and social science,
- to describe the structure and objectives of energy policy of major countries including Japan,
- to comprehensively understand energy statistics and other data and describe it with relation to world energy trends

[Course schedule and contents]

1. Overview of energy policy
2. Energy resource: characteristics, supply and demand (1)
3. Energy resource: characteristics, supply and demand (2)
4. Renewable energy: characteristics, policy implementation (1)
5. Renewable energy: characteristics, policy implementation (2)
6. Nuclear energy: characteristics, policy implementation (1)
7. Nuclear energy: characteristics, policy implementation (2)
8. Energy and environment
9. Energy efficiency and energy policy
10. Energy policy of Japan and major countries (1)
11. Energy policy of Japan and major countries (2)
12. Forecasts and outlooks of energy supply and demand (1)
13. Forecasts and outlooks of energy supply and demand (2)
14. Energy poverty, Energy and Water, recent topics
15. Summary

Continue to Energy Policy(2)↓ ↓ ↓

Energy Policy(2)

[Course requirements]

Students who have already taken 「**エネルギー政策論**」（3146000）(Spring Semester / in Japanese) are not allowed to take this class.

[Evaluation methods and policy]

By attendance (40%) and research presentation / final report (60%).

Note: attendance to research presentation / submission of final report is not allowed in case of class attendance rate is less than 70%

[Textbooks]

Handouts will be distributed.

Attendees are recommended to review their own countries' recent energy policy trends, as well as the IEA World Energy Outlook executive summary, which could be downloaded from IEA Web page.

[References, etc.]

（Reference books）

Recommendation of related references (books, reports, journal papers etc) will be given during the class.

[Study outside of class (preparation and review)]

Recent energy situation are extremely fluctuating and dynamic; attendees are recommended to collect up-todate information on energy policy and related topics.

（Other information (office hours, etc.)）

- Technical tour to power plants and energy-related facilities may be included as a part of the class.

*Please visit KULASIS to find out about office hours.

Course number	G-ENE20 63174 LE17		
Course title (and course title in English)	Energy, materials and resources Energy, materials and resources	Instructor's name, job title, and department of affiliation	Graduate School of Energy Science Professor,MCLELLAN, Benjamin

Target year	Master's students	Number of credits	2	Year/semesters	2023/Second semester
Days and periods	Wed.2	Class style	Lecture	Language of instruction	English

[Overview and purpose of the course]

Energy and materials are vitally linked, in their production and utilisation, and are crucial for society. All energy and materials are ultimately reliant on various resources, principal among which are the non-renewable mineral resources. This course will examine the bi-directional link of materials and energy, and the resources on which they are dependent - particularly critical minerals.

[Course objectives]

Students will obtain an understanding of various materials and the energy use in their production, as well as the use of various materials in energy systems. The concepts of material criticality will be introduced, and the students will obtain an understanding of the key elements of criticality assessment and its strategic importance.

[Course schedule and contents]

The general course topics will be as follows:
1. Overview of materials, energy and resources
2. Typical materials and energy lifecycles 1
3. Typical materials and energy lifecycles 2
4. Non-renewable resources and models
5. Renewable resources and models
6. Material criticality frameworks
7. Material criticality 1 - Supply Risk
8. Material criticality 2 - Vulnerability to Supply Restriction
9. Recycling and renewability
10. Substitutes and substitutability
11. Material criticality 3 - Environmental Impacts
12. Energy scenarios and materials - 1
13. Energy scenarios and materials - 2
14. Resource curse and social implications of energy
15. Feedback

The exact order of topics may change. Some additional topics - particularly classes with a focus on a particular material - may be added.

The final class will have student presentations.

Continue to Energy, materials and resources(2)↓↓↓

Energy, materials and resources(2)

[Course requirements]

None

[Evaluation methods and policy]

Evaluation in the subject will be based on:
Class performance: participation and short mid-term exercises (40%)
Final week presentation (10%)
Final report (50%)

These will be evaluated according to the grade evaluation policy of the Graduate School of Energy Science

[Textbooks]

Not used

[References, etc.]

（Reference books）

Reading list will be supplied on PandA.

[Study outside of class (preparation and review)]

Some short exercises will be provided for students to undertake out of class.
Pre-reading may be provided.

（Other information (office hours, etc.)）

Office hours are not set - consultation is available by prior appointment.

*Please visit KULASIS to find out about office hours.

Course number	G-ENE20 68022 LE28　G-ENE20 68022 LE77		
Course title (and course title in English)	Advanced Energy Conversion Science Advanced Energy Conversion Science	Instructor's name, job title, and department of affiliation	Graduate School of Energy Science 変換科学専攻教員全員 Graduate School of Energy Science Professor,Jun HAYASHI Graduate School of Energy Science Professor,KAWANABE HIROSHI Graduate School of Energy Science Professor,SUMIGAWA TAKASHI Graduate School of Energy Science Professor,IMATANI SHIYOUJI Institute of Advanced Energy Professor,NAGASAKI KAZUNOBU Graduate School of Energy Science Associate Professor,HORIBE NAOTO Graduate School of Energy Science Associate Professor,ABE MASATAKA Graduate School of Energy Science Associate Professor,KINOSHITA KATSUYUKI Institute of Advanced Energy Associate Professor,YAGI JURO Institute of Advanced Energy Associate Professor,KOBAYASHI SHINJI Institute of Advanced Energy Associate Professor,MORISHITA KAZUNORI

Target year	修士・博士	Number of credits	2	Year/semesters	2023/Second semester
Days and periods	Wed.3	Class style	Lecture	Language of instruction	English

[Overview and purpose of the course]

Subjects on the conversion, control and utilization of various kinds of energy from viewpoints of science and engineering are offered.

[Course objectives]

To understand subjects on the conversion, control and utilization of various kinds of energy

[Course schedule and contents]

Latest topics about energy conversion systems and their functional design are lectured in an omnibus class.

- Thermal Efficiency and Pollutant Emissions in Internal Combustion Engines
- Fundamental Research for Advanced Combustion Systems
- Laser Diagnostics for Combustion Research
- Ceramics and Their Applications to Energy-Related Machineries
- Energy Components and High Temperature Machine Design
- Nondestructive Evaluation for Energy Equipment and Materials
- Fusion Energy Conversion
- High temperature liquids for energy conversion
- Energy Conversion System for Electromagnetic Waves and Particle Beam

Continue to Advanced Energy Conversion Science(2)↓↓↓

Advanced Energy Conversion Science(2)

・Modeling of Radiation Damage Processes in Fusion Materials

[Course requirements]

None

[Evaluation methods and policy]

Attendance and report

[Textbooks]

Additional articles and documents are delivered if necessary.

[References, etc.]

（Reference books）

Introduced during class

[Study outside of class (preparation and review)]

To be announced in class.

（Other information (office hours, etc.)）

*Please visit KULASIS to find out about office hours.

Course number	G-ENE20 63132 LE24		
Course title (and course title in English)	System Safety System Safety	Instructor's name, job title, and department of affiliation	Graduate School of Energy Science Professor,SHIMODA HIROSHI

Target year	Master's students	Number of credits	2	Year/semesters	2023/Second semester
Days and periods	Wed.4	Class style	Lecture	Language of instruction	English

[Overview and purpose of the course]

From the viewpoint of keeping safety and reliability in the context of relationship between advanced technologies and human society, basic knowledge and applications of risk assessment for large-scale and complicated modern energy systems will be lectured.

[Course objectives]

Regarding risk assessment to secure safety of energy systems, the students learn the following knowledge and techniques;
1. Qualitative analysis method of risk.
2. Quantitative risk analysis method of mechanical systems.
3. Human reliability analysis method.

[Course schedule and contents]

The following themes will be lectured in regard to basic knowledge and application of risk assessment of large-scale and complicated technology systems.

1. Safety system for social relief (1).
2. Features and problems of large-scale and complicated technology systems (1).
3. Risk assessment of large-scale and complicated technology systems (3).
4. Probabilistic risk assessment(PRA) as quantitative assessment method (6).
5. Basic knowledge of human factor (1).
6. Analysis of human error and its countermeasures (1).
7. Human reliability analysis(HRA) (1).
8. Feedback (1).

[Course requirements]

None

Continue to System Safety(2)↓ ↓ ↓

System Safety(2)

[Evaluation methods and policy]

The grade will be evaluated according to the grade evaluation policy of the Graduate School of Energy Science. Concretely,
Active participation in the classes (20%),
Exercises in the class and homework (40%),
Final report subject (40%).

[Textbooks]

Learning materials will be given in the class.

[References, etc.]

（Reference books）

Introduced during class

[Study outside of class (preparation and review)]

Preparation, review and homework will be given in the class.

（Other information (office hours, etc.)）

*Please visit KULASIS to find out about office hours.