AY2017-2018 IESC COURSE TITLES – MASTER'S

Subject Code	Lecture Subject Title	Lecturer	Hours per Week		Credits	Note
			Spring Semester	Fall Semester		
3118000	☆□Energy Systems Analysis and Design	Tezuka		2	2	Offered in 2018
3132000	☆○System Safety	Shimoda		2	2	
3172000	☆Energy Policy	Unesaki		2	2	
3170000	☆Future Energy: Hydrogen Economy	McLellan	2		2	
3167000	☆Energy and SD (Energy Systems and Sustainable Development)	McLellan		2	2	
3249000	☆Fundamental Plasma Simulation	Kishimoto		2	2	
3392000	☆□Fusion Energy Science and Technology (Fusion Energy Science and Technology)	Konishi・Nagasaki・Kimura		2	2	Offered in 2018
3393000	☆○Energy Conversion System Design (Energy Conversion Systems and Functional Design)	Ishiyama・Hoshide・Imatani		2	2	
3477000	☆Energy Efficiency and Management	Farzaneh	2		2	
3478000	☆Fuel Technology	Farzaneh		2	2	
8022000	☆◇Advanced Energy Conversion Science	All		2	2	

LEGEND

1. SUBJECTS MARKED WITH THE SYMBOL "○" ARE OFFERED EVERY OTHER YEAR AND OFFERED THIS YEAR BUT NOT NEXT YEAR.
2. SUBJECTS MARKED WITH THE SYMBOL "□" ARE OFFERED EVERY OTHER YEAR AND OFFERED NEXT YEAR BUT NOT THIS YEAR.
3. SUBJECTS MARKED WITH THE SYMBOL "◇" ARE SUBJECTS FOR THE DOCTORAL PROGRAMS.
4. THE TEACHING STAFF RESPONSIBLE FOR A SUBJECT AND THE TEACHING PERIOD MAY BE SUBJECT TO CHANGE FOR A GIVEN YEAR.

INFORMATION ON NON-IESC JAPANESE COURSES

The course information of the GSES courses taught in Japanese will be found on KULASIS and on the GSES' 'Academic Year 2017 Graduate School Handbook and Syllabi'. （大学院学修要覧）

INFORMATION OF NON-GSES COURSES

Information on courses offered by the other graduate schools/faculties is partially available on KULASIS and at the Student Affairs Section of the relevant graduate school/ faculty office. Students should contact the relevant school's office and/or the instructor of the course for specific questions and availability.

AY 2017 FALL SEMESTER LECTURE SYLLABI

Code	3132000		
Course title <English>	System Safety	Affiliated department, Job title, Name	H. Shimoda

Grade alloted	Master's	Number of credits	2	Course offered year/period	2017 Fall		
Day/period	Wednesday, 4th	Class style	Lecture			Language	English

[Outline 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 Goals]

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).

[Class requirement]

none

[Method, Point of view, and Attainment levels of Evaluation]

Active participation in the classes (30%),
Exercises in the class and homework (30%),
Final report subject (40%).

[Textbook]

Learning materials will be given in the class.

[Reference book, etc.]

Introduced in the classes

[Regarding studies out of class (preparation and review)]

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

[Others (office hour, etc.)]

Code	3172000	Affiliated department, Job title, Name	H. Unesaki
Course title <English>	Energy Policy		

Grade alloted	Master's	Number of credits	2	Course offered year/period	2017 Fall
Day/period	Wednesday, 1st	Class style	lecture	Language	English

[Outline 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 Goals]

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

[Class requirement]

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

[Method, Point of view, and Attainment levels of Evaluation]

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%

[Textbook]

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.

[Reference book, etc.]

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

[Regarding studies out 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.

[Others (office hour, etc.)]

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

Code	3167000	Affiliated department, Job title, Name	B. McLellan
Course title <English>	Energy and SD Energy Systems and Sustainable Development		

Grade alloted	Master's	Number of credits	2	Course offered year/period	2017 Fall
Day/period	Tuesday, 2nd	Class style	Lecture	Language	English

[Outline 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 Goals]

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):
1. Sustainable development and sustainability concepts
2. Frameworks for understanding sustainability
3. Life cycle assessment of energy systems (and connections with water, pollution and resource usage) [3-4 weeks]
4. Non-renewable energy technology
5. Renewable energy technology
6. Energy in developing countries
7. Infrastructure configurations for energy delivery
8. Measurement and decision making for sustainability.
Followed by 3 weeks of workshop.

[Class requirement]

None

[Method, Point of view, and Attainment levels of Evaluation]

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 3 week workshop capping-off the course (30%)
3. Submission of a final report (30%)

[Textbook]

Not used

[Reference book, etc.]

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

[Regarding studies out 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.

[Others (office hour, etc.)]

Available by appointment.

Code	8022000	Affiliated department, Job title, Name	ECS faculty
Course title <English>	Advanced Energy Conversion Science		

Grade alloted	Master's / Doctoral	Number of credits	2	Course offered year/period	2017 Fall
Day/period	Wednesday, 3rd	Class style	Lecture	Language	English

[Outline 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 Goals]

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
・Laser Diagnostics for Combustion Research
・Alternative Fuels in Combustion Systems
・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
・Nuclear Energy Materials
・Energy Conversion System for Electromagnetic Waves and Particle Beam
・Recent Progress in Fusion Structural Materials R&D
・Modeling of Radiation Damage Processes in Fusion Materials

[Class requirement]

none

[Method, Point of view, and Attainment levels of Evaluation]

Attendance and report

[Textbook]

Additional articles and documents are delivered if necessary.

[Reference book, etc.]

Reference books are introduced in class.

[Regarding studies out of class (preparation and review)]

To be announced in class.

[Others (office hour, etc.)]

Code	3249000		
Course title <English>	Fundamental Plasma Simulation	Affiliated department, Job title, Name	Y. Kishimoto

Grade alloted	Master's	Number of credits	2	Course offered year/period	2017 Fall
Day/period	Tuesday, 4th	Class style	Lecture	Language	English

[Outline and Purpose of the Course]

This lecture aims at formally introducing basic statistical description of wide class of plasma. Characteristics of individual and collective behaviors of plasmas and that of associated fluctuation and dissipation are studied following kinetic modeling, which are the basis of numerical simulation of plasmas in magnetically confined fusion plasmas, laser-plasma interaction, space plasmas and astrophysical physics.

[Course Goals]

1.Understanding of plasma based on kinetic model and of the individual and collective characteristics.
2.Understanding of the dispersion relation in plasma and specifically wave-particle interaction emphasizing on Landau damping.
3.Understanding of the characteristics of fluctuation and dissipation in plasmas based on the statistical approach and the role on plasma numerical simulation.

[Course Schedule and Contents]

The class will be arranged as a seminar style according to following subjects.
1.Definition of plasma and the concept of Debye shielding and plasma oscillation (2 weeks)
2.Kinetic description of plasmas leading to dispersion relation (2 weeks)
3.Collective nature of plasma emphasizing on Landau damping (3 weeks)
4.Fluctuation and dissipation of plasma and their kinetic description (3 weeks)
5.Simulation methodology of plasma based on kinetic and fluid approach (2 weeks)
6.Example of fundamental plasma simulation based on kinetic and fluid model (2 weeks)

[Class requirement]

none

[Method, Point of view, and Attainment levels of Evaluation]

Paper examination and report

[Textbook]

Introduced in the classes

[Reference book, etc.]

・S.Ichimaru, Basic Principle of Plasma Physics:A Statistical Approach, Frontiers in Physics Lecture Note Series
・L. Landau,"On the vibration of the Electric Plasma", J.Phys.U.S.S.R.10, 25 (1946)

[Regarding studies out of class (preparation and review)]

Basic knowledge: Electromagnetics; Fundamental course of plasma physics.

[Others (office hour, etc.)]

Code	3393000	Affiliated department, Job title, Name	Ishiyama・Hoshide・Imatani
Course title <English>	Energy Conversion System Design (Energy Conversion Systems and Functional Design)		

Grade alloted	Master's	Number of credits	2	Course offered year/period	2017 Fall
Day/period	Tuesday, 1st	Class style	Lecture	Language	English

[Outline 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 Goals]
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]
Latest topics about energy conversion systems and their functional design are lectured.

1. Thermal Efficiency and Pollutant Emissions in Internal Combustion Engines (4-5 weeks)
Fundamentals of reciprocating internal combustion engines
Spark-ignition and diesel engines
Technologies for clean and high-efficiency engines

2. Strength Analysis for Design of Energy-Related Structures (4-5 weeks)
Fundamentals of fracture mechanics for structural design
Fatigue properties of metallic materials
Statistical analysis of material strength
Ceramics and their applications to energy-related machinery

3. Modeling and Analyses of Solids and Structures (4-5 weeks)
Elements of continuum mechanics
Constitutive modeling of complex materials
Computational mechanics of solids and structures

[Class requirement]
None

[Method, Point of view, and Attainment levels of Evaluation]
Attendance and report

[Textbook]
Handouts

[Reference book, etc.]
To be announced in class

[Regarding studies out of class (preparation and review)]
To be announced in class if necessary.

[Others (office hour, etc.)]

Code	3478000		
Course title <English>	Fuel Technology	Affiliated department, Job title, Name	H.FARZANEH

Grade alloted	Master's	Number of credits	2	Course offered year/period	2017 Fall
Day/period	Thursday, 4th	Class style	Lecture	Language	English

[Outline and Purpose of the Course]

This course is designed to equip graduates with a broad training in, and understanding of, fossil fuel production, delivery, consumption, efficiency, economics, policy and regulation.Learning in this course is facilitated through lecture, readings, discussion, in class exercises and term projects. Analytical skills are developed and demonstrated through problem sets and a term project.

[Course Goals]

On successful completion of this course, students will be able to:
1)be familiar with the technical and some economic aspects of a wide range of current and future technologies for fossil fuel generation, conversion, storage, and end usage.
2)develop the ability to critically evaluate prospects and challenges for current and proposed fuel technologies.
3)develop the ability to ask critical questions and to effectively search for accurate information.

[Course Schedule and Contents]

Week 1: Fossil fuel resources: The origins of coal, oil and gas and how they are formed, Classification of fossil fuel resources including conventional fuel, nonconventional fuel and synthetic fuels.
Week 2: Extracting and processing oil and gas: Introduction to the petrology, Nature of crude petroleum, Reservoir characterization and performance, Upstream industry; production, separation and treatment processes.
Week 3: Oil Refining and Gas Treatment: Petroleum refinery configurations and processes, Oil products properties and specifications, Refining gas and gas to liquids (GTL) technologies, Natural Gas Liquids (NGL) and Liquefied Petroleum Gas (LPG) extraction from natural gas and Liquefied Natural Gas (LNG) process.
Week 4: Coal: Coal formation, resources, extraction, classification, composition, preparation, storage, transportation and handling.
Week 5: Synthesis fuels: Syngas production from coal, Biomass, Municipal waste, Steam reforming. Watergas shift reaction. FischerTropsch synthesis of alkanes, biodiesel, Coal gasification and Liquefaction process.
Week 6: Fuel Combustion: Principle of combustion, Heating Values, Concept of excess air and drafting system, Methods for improving the combustion efficiency, Combustion of coal on grates, Combustion of fuel in Fluidized Beds, Industrial burners and Furnaces.
Week 7-8: Thermal power plants: Review of thermodynamics concepts of energy systems, Thermal power plants; steam turbine, gas turbine, Advanced combustion cycle for maximum efficiency; supercritical and combined cycles, Co-generation & CHP and their applications.
Week 9: Transportation energy technologies: Internal combustion systems, Criteria for Measuring vehicle performance, Endpoint technologies for carbon-free transportation system and options for improving conventional vehicle efficiency.
Week 10: Transition to nonconventional alternatives: History, present, and projected distributions of nonconventional fuels, Classification of nonconventional fuels; Tar sand, shale gas, shale oil, methane hydrates and Coal-bed methane.
Week 11: Environmental impacts of fossil fuel combustion: Energy use and CO2 emissions trends, CO2 emissions comparison and a “Decarbonization” Strategy; Kaya equation: factors that contribute to overall CO2 emissions.
Week 12: Carbon sequestration: Overall comparison of sequestration options, Carbon Capture and Storage (CCS) systems, Oil Enhance Recovery by CCS technology.
Week 13: Fossil fuel markets: Present use and resource considerations of fossil fuels, Concept of Peak oil, Hubbert curve applied to resource lifetime, Oil price volatility; Oil price forecasting, Introducing to OPEC game, Levelized Cost of Electricity from fossil fuel and the role of LNG pricing.
Week 14: Discussion and group project presentations.

[Class requirement]
none
[Method, Point of view, and Attainment levels of Evaluation]
20% class participation, 30% problem sets, approximately four and 50% final project. - Instead of a final exam, each student will submit, by the last day of reading period, a final paper reporting a final project. The project should be the in-depth study of the technical or techno-economic aspects of some topics in fuel technology, chosen in consultation with the teaching staff. - There will be about four homework sets distributed over the ~12-week semester and will be due at the start of class. Solutions to the problems will typically be handed out at the first class following the due date.
[Textbook]
Introduced in the classes
[Reference book, etc.]
Francis, W. and Peters, M.C『Fuels and Fuel Technology』(Elsevier) ISBN:9781483147949 Cassedy, E.S., Grossman, P.Z『Introduction to Energy Resources, Technology and Society』(Cambridge University Press) Aziz, M.J. and Johnson, A.C『Introduction to energy technology, Depletable and renewable』ISBN:978-3-527- 33241-0
[Regarding studies out of class (preparation and review)]
none
[Others (office hour, etc.)]
none