

Outline of the Program Curriculum

The Nagoya University Civil and Environmental Engineering Group offers the following courses in English within a comprehensive and interdisciplinary curriculum. Master's program students are required to obtain a minimum of 30 credits mainly as well as to defend their Master's thesis.

| | |--| | Target: Basic Knowledge and Skills as a Leader | |--|

Sustainability and Environmental Studies (Lecture, 2 credits)

by Associated Faculty

This course aims to deepen students' understanding of "sustainable development", a central concept in environmental studies, through lectures that examine activities and approaches across a range of fields. The objective of this course is to acquire the following knowledge and skills. 1) Explain sustainability within environmental studies from three perspectives: a) Society and the social sciences, b) Natural-science observation and analysis, and c) Urban and spatial perspectives. 2) Explain sustainability with reference to the concept of safety.

English Communication in Environmental Issues (Lecture, 2 credits)

by Miho IRYO and Sohyun CHUN

International communication skills are indispensable to propose policies that address environmental issues in the international communities. This lecture aims to improve international communication skills through analysis, policy proposals and discussions on environmental issues. The objective of this lecture is to acquire the following knowledge and skills. 1) Understand and apply effective presentation and discussion techniques in English. 2) Understand the environmental issues in various countries and the differences in how environmental issues are perceived by different standpoints. 3) Based on opinions from other perspectives, they can explain their points logically and persuade others.

Frontier in Civil Engineering (Lecture, 2 credits)

by Associated Faculty

The aim of the lecture is to comprehensively examine the framework of civil engineering through the introductions of various research topics, projects and so on which the staff of civil engineering have investigated in recent years. After completing this course, students will be able to 1) explain various recent issues in civil engineering fields, and 2) establish a comprehensive perspective in civil engineering.

Civil Engineering and Policies for Developing Countries I (Lecture, 2 credits)

by Miho IRYO, Hiroto SHIRAKI and Kiichiro HAYASHI

The objective of this course is to learn the basic knowledge related to sustainable development, environmental management, and international cooperation in developing countries for infrastructure development.

[Course topics] 1. Development 2. Development and agriculture 3. Development and industrialization 4. Sustainable development 5. MDGs and SDGs 6. Environment and resource issues in developing countries 7. International environmental management (international treaty, international organization) 8. International cooperation.

Civil Engineering and Policies for Developing Countries II (Lecture, 2 credits)

by Associated Faculty

The objectives of this course are 1) to study the fundamental knowledge on planning, design, construction and maintenance of infrastructure in Japan, as well as developing countries, 2) to survey various issues in civil engineering, including the environmental problems and recent development of regional disaster mitigation activities.

[Course topics] 1. Disaster risk assessment 2. Water resources and river basin management 3. Coastal zone management 4. Infrastructure development under aid programs 5. Infrastructure projects in developing countries.

Target: Advanced Technologies and Knowledge

Environmental Systems Analysis and Planning (Lecture, 2 credits)

by Hiroki TANIKAWA

Through this course, students will understand “environmental systems” listed as follows. 1) the interaction of human activities and nature, 2) the scientific mechanisms of global environmental problems, such as climate change, 3) the basic principles and methods of analyzing environmental systems, e.g., environmental economics, mathematical models, life-cycle assessment, etc., and 4) the principle and methods of environmental management at local, national and global scales.

[Course Topics] 1. About Environmental System Analysis 2. Carrying Capacity, Water, Energy, Material Flow/Stock 3. Simple Global Warming modeling 4. Industrial Symbiosis modeling 5. The basis on Input and Output Analysis 6. Urban Climate Modeling.

Transportation Systems Analysis (Lecture, 2 credits)

by Tomio MIWA and Toshiyuki YAMAMOTO

To plan and evaluate efficient and sustainable transportation systems analysis, the

objectives of this lecture are to learn transportation surveys, travel demand analysis, and evaluation methods of the systems. It also aims to build capacities of using them in transportation research and practices.

[Course Topics] 1. Transportation demand and travel survey 2. Aggregate demand model (trip generation & production/attraction, trip distribution, Modal split, Traffic assignment) 3. Disaggregate demand model (binary choice, multinomial choice, estimation and statistical test, aggregation and forecast, multi-dimensional choice, advanced discrete choice models).

Advanced Traffic Engineering and Management (Lecture, 2 credits)

by Hideki NAKAMURA

Goals of the course is to understand fundamental traffic characteristics and be able to estimate variables required for highway planning and traffic operation such as highway capacity and delay, and to understand fundamentals of traffic signal control technique and to be able to set traffic signals.

[Course Topics] 1. Introduction to Traffic Engineering and Its Scope 2. Traffic Surveys 3. Macroscopic Traffic Characteristics 4. Microscopic Traffic Characteristics 5. Capacity Analysis and Breakdown Phenomena 6. Highway Planning and Level of Service 7. Fundamentals of Traffic Signal Control 8. Capacity of Unsignalized Intersections and Roundabouts.

Advanced Course in Lifecycle Design of Civil Structures (Lecture, 2 credits)

by Hikaru NAKAMURA, Takeshi HANJI and Koji NISHIGUCHI

This course objective is to study design method and maintenance of bridge structures in the context of lifecycle management of civil structures. After completing this course, students will be able to list different types of structural design methods and explain their differences, explain typical design flow of bridge structures, and understand current conditions of existing bridges and describe maintenance systems of bridges in Japan.

[Course Topics] 1. To study fundamental theory of reliability-based structural design and to understand structural reliability and different design methods such as the allowable stress method and the limit state design method 2. To understand a typical flow of structural design which includes structural planning, selection of structural systems, verification of required performances, lifecycle cost analysis, and maintenance plan, by studying design examples of steel and concrete structures 3. To understand current conditions of existing bridges in Japan and to study efficient maintenance systems of bridge structures.

Advanced Infrastructure Planning (Lecture, 2 credits)

by Tomio MIWA and Toshiyuki YAMAMOTO

The course objective is to understand the meanings and objectives of infrastructure and learn the infrastructure planning methods. The goals of the class are to be able to explain the public economy, and solve the problems to derive the appropriate results by applying the evaluation methods and decision methods considering the uncertainty.

[Course Topics] 1. Public economics (Social welfare and Pareto optimum, Consumer's behavior and demand curve, Producer's behavior and market equilibrium, Market failure, Externality, Public goods) 2. Introduction to decision making in infrastructure planning 3. Evaluation and decision making (Cost-benefit analysis and value of non-market goods, Evaluation methods of non-market goods and utility function, Value of travel time saving and project evaluation, social welfare function and analytic hierarchy process) 4. Decision making under uncertainty (Expected utility theory, Bayesian decision making and value of information, Game theory and dilemma problem).

Advanced Fluvial and Coastal Hydrodynamics (Lecture, 2 credits)

by Tomoaki NAKAMURA and Yuta MIZOGUCHI

The aim of this course is to understand physical processes in rivers and oceans. This class will provide advanced theories and technologies applied in the management of rivers and coasts.

[Course Topics] 1. Outline of the course 2. Governing equations for incompressible viscous fluid flow 3. Shallow water equations 4. Flow resistances in open-channel flow 5. Long wave theory 6. Shallow water wave theory 7. Wave-averaged conservation equations.

Advanced Geotechnical Engineering (Lecture, 2 credits)

by Kentaro NAKAI

This lecture aims to learn how the basic knowledge learned in soil mechanics and geomechanics are applying to actual geoengineering, and to understand its theoretical background. Specifically, the purpose is to learn about settlement and failure (bearing capacity) problems in soft ground, as well as how to deal with uncertainties in the actual field of geoengineering such as the safety factor method and reliability design.

[Course Topics] 1. Introduction to geotechnical engineering 2. Multi-dimensional consolidation analysis 3. Observational method for predicting consolidation settlement (Asaoka method) 4. Mean effective stress and bearing capacity 5. Undrained bearing capacity ($\varphi_u=0$ circular slip surface analysis).

Advanced Numerical Analysis (Lecture, 2 credits)

by Tomio MIWA and Kentaro NAKAI, Yuta MIZOGUCHI and Koji NISHIGUCHI

This lecture provides basic theories of numerical analyzing techniques which are often used in the civil engineering field. The goal is to understand and apply numerical optimization method, finite element method, approximate analysis of ordinary differential equation and finite difference method for computational fluid dynamics simulation through the lecture and practical work.

[Course Topics] 1. Optimization problem 2. Approximate analysis of ordinary differential equation 3. Finite difference method 4. Finite element method.

Advanced Steel Structures (Lecture, 2 credits)

by Kazuo TATEISHI

Deterioration and its prediction method for steel structures are lectured. The goal of this course is to understand the following issues: Importance of maintenance of infrastructures, Deterioration in steel structures, Calculation method for remaining life of steel members based on fracture mechanics, Fatigue and corrosion in steel members, Inspection method for steel structures.

[Course Topics] 1. Importance of maintenance and difficulties 2. Experiences of damage in steel structures and repair/retrofitting methods 3. Fatigue and preventing method 4. Linear fracture mechanics and its application 5. Corrosion and preventing method 6. Inspection method for steel structures.

Advanced Concrete Structures (Lecture, 2 credits)

by Hikaru NAKAMURA and Taito MIURA

The objective of this course is to acquire specialized knowledge about the repair and reinforcement of concrete structures and the ability that make use of the knowledge in practice. By completing this course, students will be able to understand 1) deterioration of concrete structures 2) basic concepts of structural repair and reinforcement design 3) repair materials and methods for concrete structures 4) reinforcement materials and repair methods for concrete structures.

Advanced Mechanics of Geomaterials (Lecture, 2 credits)

by Masaki NAKANO and Takayuki SAKAI

The aim of this course is to acquire the basics and applications of geomaterials mechanics for safely constructing and maintaining various geotechnical structures. Concretely, this course introduces the mechanical behavior of remolded clay and natural deposited clay, and the difference between the two. Then, the course also introduces the basics of plastic mechanics, an elasto-plastic constitutive model, and the

mechanical behavior of remolded clay and naturally deposited clay based on the constitutive model. In addition, the object is expanded to sand, problematic soil, and improved soil, and their mechanical behavior is also explained based on elasto-plastic mechanics.

Advanced Urban Planning (Lecture, 2 credits)

by Hirokazu KATO

In the state of the aging and declining population, global environmental issues and catastrophic natural disasters, you explore desired urban planning and required economic and financial systems to support it. Objectives of this course are: 1) To learn and explain the necessity of urban planning and management, its basic items and requirements, 2) To understand and explain the contents, problems and reasons for Japanese spatial planning and management, 3) To understand and explain the direction of urban spatial planning and management in Japan and developing countries in the future.

Advanced Continuum Mechanics (Lecture, 2 credits)

by Toshihiro NODA

The aims of this course are to review the concept of vector/tensor and to understand the basics of continuum mechanics such as kinematics (geometry of motion), equilibrium rules, and objectivity. Students will be able to 1) Understand and explain the basis of Vector and Tensor Analysis, 2) Explain material and spatial descriptions of the physical value of body, material/spatial time derivatives and expression of deformation of body using tensor, 3) Understand and explain properties of Cauchy's stress tensor, 4) Understand and explain law of mechanics and Cauchy's first/second law of motion, and apply them to the interpretation and representation of the mechanical behavior of continuum body.

Advanced Structural Mechanics (Lecture, 2 credits)

by Junji KATO

The objective of this course is to learn the basic knowledge of nonlinear computational mechanics and topology optimization for advanced and numerical structural design. [Course Topics] 1. Nonlinear computational mechanics based on the finite element method (Newton-Raphson method, Geometric nonlinear structural analysis, Basis of numerical instability problem) 2. Structural optimization (Foundation of mathematics of optimization, Formulation of sensitivity analysis, Topology optimization).

Advanced Coastal and Offshore Engineering (Lecture, 2 credits)

by Tomoaki NAKAMURA

The aim of this course is to understand wave dynamics in a coastal zone and wave-structure interactions. Students will be able to 1) understand and explain hydraulic phenomena related to the radiation stress, 2) understand and explain diffraction problems, 3) understand and explain wave dynamics including evanescent waves, 4) understand and explain the dynamic behavior of floating bodies.

[Course Topics] 1. Radiation stress and wave dynamics in a shallow water 2. Diffraction wave theory (vertical cylinder, axisymmetric structure) 3. Dynamic behaviour of floating bodies 4. Potential and the boundary element method 5. Green function and numerical methods.

Advanced Theory of River Basin Management (Lecture, 2 credits)

by Yuji TODA

This course aims to obtain the comprehensive understanding of the theoretical background and the recent technologies for river and river basin management. The attainment target is to get the fundamental knowledge of river basin managements and to acquire the understanding of new technologies of river engineering and fluvial hydraulics.

[Course Topics] 1. Outline of river and river basin management 2. Sediment transport 3. Fluvial Hydraulics 4. Eco-Hydraulics

Advanced Soil Dynamics (Lecture, 2 credits)

by Toshihiro NODA

In this lecture, students will know the seismic damage example such as liquefaction during the actual earthquake and will learn the basic matters and advanced contents related to the ground dynamics, such as the cyclic response of the ground during the earthquake. By learning this lecture, the goal is to be able to 1) Understand seismic damage caused by recent earthquakes 2) Understand the concept of seismic design 3) Understand the vibration mechanism of the mass / mass system 4) Understand the double reflection theory 5) Understand how to understand dynamic problems of water-soil two-phase system based on mixture theory.

| | |----------------------------------| | Target: Interdisciplinary Topics | |----------------------------------|

Environmental Industry Systems (Lecture, 2 credits)

by Hiroki TANIKAWA and Miho IRYO

The student will learn the practical skills as a leader in developing infrastructure by

learning examples of how to apply the expertise and engineering techniques related to environmental conservation activities and technologies to the real world. Lecturers are invited from companies mainly in the Chubu region, which has an advantage in environmental conservation activities and environmental technologies, for lectures on the latest environmental initiatives in business. 1) Lectures by companies and discussions: Listen to lectures on application examples of environmental conservation activities and environmental technologies from companies and discuss their contents. 2) Group presentations: Based on the contents of the lectures and the contents learned in other subjects, a group discussion will be held on the connection between theory and practice, and the results will be presented.

Sustainable City Studies (Lecture, 2 credits)

by Hiroki TANIKAWA

Students will learn policies, plans, and technological and institutional measures to realize Sustainable Society with the idea of sound material cycle society and decarbonization cities, with a view to integrating climatic change mitigation in urban development.

[Course Topics] 1. Global climatic system 2. Mechanisms of global warming 3. Climatic change and human history 4. Economy, energy and environment and IPCC AR 5. Industrial Ecology and Circular Economy 6. Human activities and energy in cities 7. Urban forms, land use and energy 8. Material and Energy metabolism in cities 9. Material and Energy metabolism of buildings and districts 10. Sound Material Cycle Society and Circular Economy 11. Metal resource and sustainability 12. Stock-type Society and sustainability.

Climate Change and Infrastructure (Lecture, 2 credits)

by Miho IRYO

This lecture aims to acquire the knowledge about the current status and risks of climate change and international initiatives, and to develop the capacity to consider mitigation and adaptation measures from the perspective of sustainable infrastructure development.

[Course Topics] 1. Scientific basis of climate change and its impact on social system (Learn about climate change and its impact on social systems based on IPCC reports.) 2. Climate change mitigation and adaptation (Through group work, learn how to analyze the potential regional risks of climate change and propose mitigation and adaptation measures.) 3. International efforts to mitigate and adapt to climate change (Learn the historical background of international climate change measures under the Framework Convention on Climate Change, and deepen your understanding of the international

decision-making process.)

Environmental Urban Systems (Lecture, 2 credits)

by Miho IRYO

The aim is to deepen the understanding of the technical and institutional systems required to build an environmental city, mainly from the perspective of city planning and transportation planning.

[Course Topics] 1. Components of urban environment and their issues 2. Historical review of city structures and location theory 3. Observation and assessment of environmental impact 4. Urban / transportation plan for environmental improvement 5. Consensus building and community development 6. Case studies of environmental improvement measures in various cities

Target: Research-oriented internship

Global Research Internship (Research training, 2 credits)

by Associated Faculty

As part of the Nagoya University Global Environmental Leaders Program, this course aims at providing research and survey opportunities at universities, research institutions, companies, governments in Japan and overseas to acquire the ability to conduct practical and applied research. Internship should be conducted based on close communication with Academic Advisor(s). Students are expected to acquire practical research know-how through On-site Research Training (ORT). Details of the internship such as period and terms of implementation should be decided through consultation with Academic Advisor(s) and experts at host institutions.