ANNEX IV: Syllabus of the Training Program (Tentative)

S-Group（Seismology Group)

Category	Title	Subtitle	Contents
Orientation	Orientation	Overview of Earthquake, Tsunami, and Disasters	Introductory lectures for seismology and tsunami are given by staff members of IISEE. Basic concepts and general scope of seismology, earthquake phenomena, strong motion study, seismic hazard and risk, and tsunami, etc. are described.
		Ethics and Literacy for Scientific Studies	We provide explanations on subjects to learn about research ethics and literacy required for scientific studies.
Basic Subjects Related with Earthquake and Disasters	Information Technology Related with Earthquakes and Disasters	Computer	Practices on FORTRAN programming for scientific computing and on UNIX and GMT are given using PC and Linux server. The basic of Python 3 programming is provided.
		Theory of Seismic Waves	Basic expressions for strain and stress relations are induced from the fundamental concept of the property of elasticity. Mathematical background of the theory of elasticity is discussed from the standpoint of specific problems such as equilibrium conditions, strain energy and transmissions of elastic waves. Reflection and refraction of plane waves are explained. P and S waves velocity distribution is discussed.
		Surface Waves	Crust and upper mantle structure inferred from surface wave analysis, including its analogies with tsunamis (surface gravity waves in the ocean) is explained.
		Scattering and Attenuation	Stochastic modeling and measurement of small-scale heterogeneities and intrinsic attenuation of seismic waves in the crust are explained.
	Earthquake Phenomenology	Earthquake Observation (1), (2)*	Basic theory of seismometers is explained. A method for calibration of conventional type of short period seismometer is presented with a practical training. Data acquisition and seismic telemetry systems are explained.
		Local Earthquake Analyses (1)	Analyses of seismograms obtained by local networks, e.g., Wadati diagram, particle motion, apparent velocity, hypocenter determination, and magnitude.
		Local Earthquake Analyses (2)*	Practical analyses of seismograms obtained by local network, e.g., Earthquake location for a homogeneous medium, location errors, iterative weighting, and application.
		Teleseismic Phases and Magnitudes	Teleseismic phases and typical magnitude scales are explained. The Earth's normal modes and their relations to seismic phases are introduced.
		Earthquake Early Warning (1)	The methodologies of Earthquake Early Warning (EEW) are explained, and then actual operation of the system is discussed. Experience of actual operation of nationwide EEW system by the Japan Meteorological Agency is also given.
		Earthquake Early Warning (2)*	This lecture introduces the general concept of an earthquake early warning (EEW) system and its practical examples. This lecture also has an exercise using PC. We will determine the P-wave arrival time and compute amplitude and period parameters which will be used for EEW system.
		Seismicity and Statistics*	This course aims to give a basic introduction to statistical techniques that are useful in the study of seismicity. Several statistical techniques and models are introduced and discussed alongside the well-known

			empirical laws. This course also provides hands-on practical sessions using computer software to analyze seismic activity data.
		Crust and Upper Mantle Structure	Crust and upper mantle structure inferred from explosion seismic and surface methods are explained.
		Crustal Deformation	Introductory course of crustal deformation including geodetic survey and continuous measurement with special references to the problems on modeling of earthquake and volcanic events and earthquake forecasting.
	Seminar of Basic Seismology		Discussion, presentation and practice for the topics of Basic Seismology
Advanced Subjects Related with Earthquake and Disasters	Earthquake Circumstance	Earthquake Generation and Forecasting (1)	Earthquake dynamics and scaling laws are explained. Earthquake preparation processes and research on short-term prediction are introduced.
		Earthquake Generation and Forecasting (2)*	Earthquake cycles and long- and intermediate-term prediction are introduced.
		Mathematics for Seismology	Basic concepts and technique of applied mathematics used often in the field of seismology are explained. Subjects include linear differential equations, Fourier analysis, matrix algebra and vector analysis. Practice of applied mathematics is also given.
		Focal Mechanism	Basic knowledge and practice for determination of focal mechanism by P-wave first motion method.
		Moment Tensor Analysis	Basic knowledge and practice for determination of focal mechanism by moment tensor inversion method.
		Earthquake and Plate Tectonics*	The basic concept of plate tectonics is presented. Methods to obtain plate motions are described.
		Earthquake Source Process*	The main purpose of this lecture is to provide you with basic earthquake source models and conception of earthquake source process, showing techniques to synthesize seismic waves from the source models and to determine the parameters that can describe earthquake source process.
	Characteristics of Earthquake Disasters	Data Processing	Theory and practice of the least squares method used for seismological analyses and those of Discrete Fourier transform, and digital filter are introduced.
		Study Tour of Earthquake Monitoring*	Study tours to institutes which have observational networks to monitor earthquakes are conducted.
		Real Time Determination of Source Parameter*	Real time determination of source parameters (local event) is introduced.
		Determination of Broadband Moment Magnitude	Broadband moment magnitude (Mwp) is a magnitude determined by processing of first arriving P-waves, and has been adopted by tsunami warning centers. First, this magnitude scale is explained in the lecture. Then, computer practices to determine this magnitude are provided.
		Effect of Surface Geology on Seismic Motion (1)	Effects of surface geology on seismic motion (ESG) are explained by showing results of ground motion case studies: amplification mechanisms of seismic waves, actual examples of site amplifications at sites with various site conditions, relations with earthquake damage.
		Effect of Surface Geology on Seismic Motion (2)	Subsurface explorations and strong motion synthetic techniques are explained in detail.
		Seismic Tomography*	Theory and application of seismic tomography in local, regional, and global scales are explained. Practice on computer is also given.

		Numerical Simulation of Seismic Wave Propagation	Basic theory of seismic wave propagation and numerical methods for solving the elastic equations are explained. Seismic wave propagation is demonstrated by animation made by computer. Practice on the numerical simulation is given by using PC.
	Special Topics	Observation Visits	Observation tour to the institutes that have notable activities in the field of Earthquake and Tsunami Science.
		Tsunami and Earthquake*	Basic concept and overview of tsunamis, including tsunami generation, propagation and tsunami warning and hazard reduction systems.
		Earthquake Geology*	Geological subjects related to earthquake prediction, hazard assessment and countermeasures.
		Education of Tsunami Disaster reduction and International Tsunami Warning System*	UNESCO lecturer introduces educational activities for tsunami disaster reduction and international tsunami warning system.
		Japanese ODA Policy and Development Assistance Related with Disaster Management	Japanese ODA policy and implementation and the international trend of development assistance related with disaster management activities including poverty and gender issues are explained.
		How to write a Scientific Report	Lecture for effective writing research reports (papers) will be given by an English native editor.
		Study Tour of Earthquake Monitoring	Observation tour to the institutes that have notable activities in the field of Earthquake and Tsunami Science.
		Study Trip	Study trip to western part of Japan (Kansai) etc.
	Seminar of Applied Seismology		Discussion, presentation and practice for the topics of Applied Seismology
Earthquake Hazard and Risk Assessment	Earthquake Hazard Assessment A	Soil Test and Survey	Geotechnical field investigation and laboratory testing methods are discussed in this lecture. An emphasis is placed on providing the information about currently used practical methods.
		Strong Earthquake Motion Observation*	General procedures and system of a strong-motion earthquake observation are presented. Participants are introduced to the principle of strong-motion accelerometers (SMAC), data acquisition systems and data analysis procedures. Application of strong earthquake ground motion to seismic-resisting design is explained.
		Soil Dynamics	Fundamental properties of soil such as non-linearity and constitutive law are reviewed. Dynamic behavior of soil deposits and analytical method are explained with evaluation of material constants. Liquefaction of sand deposits is discussed and countermeasures against liquefaction are introduced.
		Strong Ground Motion Study I (Probabilistic Seismic Hazard Analysis)	Seismic Hazard Assessment is discussed, that is an estimation of the likelihood of an earthquake occurrence and its magnitude in and around the location of interest and of the severity of strong ground motions expected for a certain return period.
		Strong Ground Motion Study II (Strong Motion Seismology)	Strong-motion seismology is concerned with high frequency seismic waves from large earthquakes. Its ultimate goal is to predict strong ground motion from the basic understanding of fault mechanics and seismic wave propagation in the Earth.
	Earthquake Hazard Assessment B	Microtremor Observation (1)*	Practice in the field and analysis are introduced for microtremor that is one of the useful information to evaluate the characteristics of earthquake ground motion.
		Microtremor Observation	Field practice of microtremor array observation.

		(2)	
		Simulation of Seismic Ground Motion	Method to estimate the strong ground motion at the engineering bedrock based on the empirical formulas is explained.
		Geophysical Prospecting	Principles of seismic refraction and reflection and their applications to the real field are discussed.
		Seismic Micro-zonation*	This lecture gives an introduction to seismic micro-zoning technique by presenting the methods to estimate the distribution of the local and regional seismic hazard, explaining the preparation process of seismic scenarios, describing the applications of micro-zoning results, and discussing the future of micro-zoning. Various examples of actual studies are also presented.
Case Studies	Practice for Earthquake Disaster – Recovery Management Policy I, II & III	Study trip	Study trip to north-eastern part of Japan (Tohoku)etc.
		Practice for the topics of Earthquake Disaster Management	Three colloquiums are planned: 1) for the report on the seismic observation and its results in the countries of each participant, 2) for the practice of reading scientific papers, and 3) for explaining the plan of individual study.
		International Seminar for Disaster Management	Observation Visit to Life Safety Learning Center, Edo-Tokyo Museum etc.
Master Thesis Seminar.	Master Thesis Seminar.		During the master thesis seminar period, each participant makes a research on a specific subject and writes a paper under the direction of an instructor. The subject is selected in the list shown in ANNEX I.
Disaster Management Policy (for Master Program)	Disaster Management Policies A: from Regional and Infrastructure Aspect		This course deals with the various aspects of disaster management policies from the viewpoint of infrastructure development. It emphasizes understanding the mechanism of natural disasters and measures against it. The course consists of four parts: I) Introductory lecture to overlook disaster management policies II) Lectures in specialized fields on practical measures against natural disasters III) Site-visiting in central Tokyo IV) Presentations by students and overall discussions The 3rd and 4th are jointly managed with DMP(B).
	Disaster Management Policies B: from Urban and Community Aspect		This course aims to provide a broad understanding of disaster risk management, policies related to urban, housing and community aspects. It emphasizes application of appropriate and practical measures, reflecting social, economic and environmental conditions of each country. This course also attempts to discuss the following issues: - Basic issues of the disaster management policies - Lessons from the past large disasters in the world - Urban Disaster risk management policy in Japan - Politics and regulations to secure building safety - Site-visiting in central Tokyo, presentations by students and overall discussions are jointly managed with DMP(A).

*: included in the syllabus of the Master Thesis Seminar.

E-Group (Earthquake Engineering Group)

Category	Title	Subtitle	Contents
Orientation	Orientation	Ethics and Literacy for Scientific Studies	We provide explanations on subjects to learn about research ethics and literacy required for scientific studies.
		Introduction to Earthquake Engineering	Basic concepts and damage aspects by past earthquakes in Japan are presented as an introductory lecture for engineering course.
		Introduction to Seismology	Seismology for earthquake engineers is introduced focusing on the feature of strong ground motion and its generation, propagation and amplification process.
		Computer	The lecture introduces the computer environment at Building Research Institute (BRI) and International Institute of Seismology and Earthquake Engineering (IISEE). Usage and instructions of the provided laptop PC and the preinstalled software are also given in the lecture.
Basic Subjects Related with Earthquake and Disasters	Structural Analysis	Structural Analysis	Fundamental concepts and principles which are utilized in the current structural analysis are introduced in the matrix algebra language. The displacement method and the force method with some extension to the finite element method and the elastic-plastic analysis of structures are discussed in some detail. Also, fundamental theories for non-linear analyses of building structures are introduced. Some member models and basic concepts of the direct stiffness method are discussed. These theories are also learned with some exercises using available software in IISEE.
		Finite Element Method I	The lecture covers 1) Basic concepts of finite element method, 2) Procedures for static linear analysis, 3) Formulation of some elements' matrices and 4) Example programs.
		Finite Element Method II*	The lecture covers 1) Aims and Material Modeling, 2) Cracks width analysis and 3) Dynamic Analyses of RC Frames.
		Limit Analysis*	Fundamentals of limit analysis (plastic analysis) as well as plastic design of structures are presented. Basic theorems in the limit analysis, safe and unsafe theorems, are introduced, and how to use them when computing the load carrying capacity of a framed structure is illustrated.
		Soil Mechanics*	This lecture covers an introduction to fundamental soil mechanics which gives the basis for understanding dynamic behaviors of soil and foundation.
	Seminar of Structure Analysis		Discussion, presentation and practice for the topic of Structural Analysis
	Ground Vibration and Structural Dynamics	Structural Dynamics I, II	The objective of this subject is to study the behavior of structures by dynamic loadings. The lecture covers the SDOF (single-degree-of-freedom) system to the MDOF (multi-degree-of-freedom) linear elastic system. The deterministic procedure is discussed in detail with exercises. Furthermore, the lecture introduces computer programming and provides some practices in programming of typical structural dynamic calculations. Participants compute dynamic response of a Single-Degree-Of-Freedom system and response spectra using Fortran 95. Fourier spectrum analysis is also introduced in the lecture.

		Structural Response Analysis*	Inelastic earthquake response analyses are explained using SDOF systems with various kind of hysteresis models and some applications of inelastic earthquake response analyses are introduced. Also, member models and structural idealization which are utilized in the current nonlinear structural analysis of buildings are outlined. Examples of dynamic and nonlinear analysis of reinforced concrete structures are presented. Methods for the theoretical interpretation on the results from the numerical analysis are introduced.
		Shaking Table Testing*	General concept of structural dynamic test is introduced. Simple shaking table test and free vibration test are practically performed using a small single mass model. Data processing technique is also discussed through the practice.
		Effect of Surface Geology on Seismic Motion I, II	Effects of surface geology on seismic motion (ESG) are explained by showing results of ground motion case studies: amplification mechanisms of seismic waves, actual examples of site amplifications at sites with various site conditions, relations with earthquake damage.
		Dynamic Soil-Structure Interaction*	In case a structure is founded on soft site, its structural behavior is strongly affected by underlying soil with each other. This phenomenon is called “Dynamic Soil-Structure Interaction (SSI)”, and is recognized as being very important for the earthquake resistance design of structure. The physical meaning of the SSI and the influence of SSI on dynamic behaviors of structure are explained.
		Microtremor Observation I*	Practice in the field and analysis are introduced for microtremor that is one of the useful information to evaluate the characteristics of earthquake ground motion.
		Microtremor Observation II*	Among many techniques for investigating subsurface shear wave velocity structure, microtremor (or ambient vibration) observation is efficient and cost-effective approach for exploration of soils and sediments. In this lecture, basics of microtremor observation techniques and data processing procedures are introduced. Field exercises on single and multiple observations are conducted.
	Seminar of Ground Vibration and Structural Dynamics		Discussion, presentation and practice for the topic of Ground Vibration and Structural Dynamics
Advanced Subjects Related with Earthquake and Disasters	Seismic Structures	RC Structures I	The structural performance from cracks to collapse about the RC members is predicted by using some equations. The prediction is made by the equations for designs.
		RC Structures II*	Detailed structural design procedure of reinforced concrete members for flexure, shear and bond is lectured. Design practice of RC members according to the presented design procedure is conducted.
		RC Structures III*	Design of Box-Shaped Wall building and evaluation of seismic performance of RC wall buildings are lectured.
		RC Structures IV*	Outline of the seismic design procedure in accordance with the Japanese codes is presented. The related codes in U.S. and New Zealand and the design guidelines currently proposed in Japan are also introduced.
		Steel Structures	Outline of the design procedure for steel building structures in Japan is explained.

		PC Structures*	General principles of prestressed concrete and several examples of precast prestressed concrete buildings are introduced. Performance of precast prestressed concrete buildings during recent earthquakes is summarized with current seismic design procedure of prestressed concrete buildings in Japan. Prestressing methods, and calculation of cracking moment and flexural strength of a beam section are lectured with employing a computer program. New seismic design methods being discussed, for example performance-based design, are also introduced with some design examples.
		Masonry Structures I*	The lecture presents structural performance and seismic design of Confined Masonry structures, which has been researched in BRI. The lecture also discusses housing construction conditions in the Third World Countries comparing with those of Japan.
		Masonry Structures II*	First, the concept and the method of seismic design of masonry structures are reviewed for several representative design codes in the world. Also, the "AIJ (Architectural Institute of Japan) Standard for the structural design of reinforced concrete hollow concrete block masonry structures" is introduced as part of the Japanese codes. Second, the seismic behavior of masonry buildings is explained from the aspects of "seismic evaluation of existing masonry buildings" and the "modeling of restoring force characteristics of masonry wall members".
		Foundation Engineering I*, II*, III*	Design concept and design procedures for static and earthquake loads for several types of foundation i.e. pile, spread and caisson foundations are presented. Furthermore, their characteristics, construction methods, selection procedures, repairing methods, etc. are explained.
		Underground Structures and Large Soil Deformations*	The lecture covers 1) Buried structures and soil deformations in earthquakes, 2) Key parameters governing performances of buried structures in earthquakes, 3) Earthquake resistant design of buried structures and future problems and 4) Other topics.
		Bridge Engineering I*, II*	Overall view of steel and concrete bridges and historical development are presented. Essential engineering issues for steel and concrete bridges are explained.
		Port & Harbor Structures and Tsunami Engineering*	Earthquake resistant design for port and harbor structures is explained with some examples of actual earthquake damage.
		Structural Testing I, II	Objectives, testing techniques, loading and measuring techniques are presented with some examples of the previous tests. Static tests for RC members are also conducted to observe structural performance.
	Seminar of Seismic Structures		Discussion, presentation and practice for the topic of Seismic Structures
	Seismic Evaluation and Seismic Design Code	Seismic Design Codes I, II, III*	Participants investigate the design concept and methods of the selected seismic codes in the world. Presentation and discussion are given for comparison of the surveyed codes. Differences in each code are discussed. Also, recent advanced concepts of seismic design codes are introduced.
		Design Earthquake Ground Motion and Seismic Force*	Seismic design code of Japan is introduced. Some international seismic design codes are also introduced and compared with each other.

		Simulation of Seismic Ground Motion	Methodology of how to generate design earthquake ground motion for engineering purpose is explained. In general, the earthquake load is considered as design seismic force. However, some buildings for special purposes are required to examine structural safety using design ground motions in time domain. A conventional methodology used for actual seismic design works is introduced.
		Seismic Micro-Zonation	This lecture introduces to seismic micro-zoning technique by presenting the methods to estimate the distribution of the local and regional seismic hazard, explaining the preparation process of seismic scenarios, describing the applications of micro-zoning results, and discussing the future of micro-zoning. Various examples of actual studies are also presented.
		Dynamic Aseismic Design I*, II*	Dynamic aseismic design procedure is introduced. Problems which frequently occur during the design of nuclear power plants and high-rise buildings are presented with some examples.
		Seismic Isolation I*, II*	Seismic isolation system is explained as one of structural response control methods. The Seismic isolation system is most effective to reduce the response and improve safety of a superstructure. Principles of the seismic isolation, merits and demerits of the seismic isolation, and behaviors of buildings with the seismically isolated buildings during earthquake are discussed.
		Structural Response Control	Basic theory on structural seismic response control and its practical applications in Japan are presented.
		Seismic Design and Retrofit of Bridges*	This lecture introduces concepts of seismic design method of highway bridges in Japan. The lecture starts from lessons learned from damage experiences in the past extreme earthquakes. Outline and concept of seismic design specifications of highway bridges in Japan are followed. Seismic assessment and retrofit design of existing bridges are presented.
	Seminar of Seismic Evaluation and Seismic Design Code		Discussion, presentation and practice for the topic of Seismic Evaluation and Seismic Design Code
Earthquake Hazard and Risk Assessment	Earthquake Hazard Assessment A	Soil Test and Survey	Soil investigation has become an important component of construction from the viewpoint of safety. Soil test helps to determine physical characteristics in order to design foundations for structures. Outline of Geotechnical investigation method is introduced in this lecture.
		Strong Earthquake Motion Observation*	Strong motion observation plays important role in the fields of earthquake engineering and building engineering. This lecture explains history and the current situation of the strong motion observation in Japan. The strong motion network of Building Research Institute and the recent research works are also introduced. Moreover, the application of the research results using strong motion data for the seismic design and the earthquake disaster mitigation are described.
		Soil Dynamics	Fundamental properties of soil such as non-linearity and constitutive law are reviewed. Dynamic behavior of soil deposits and analytical method are explained with evaluation of material constants.

		Strong Ground Motion Study I (Probabilistic Seismic Hazard Analysis)	Seismic hazard assessment is discussed, that is an estimation of the likelihood of an earthquake occurrence and its magnitude in and around the location of interest and of the severity of strong ground motions expected for a certain return period.
		Strong Ground Motion Study II (Strong Motion Seismology)	Strong-motion seismology is concerned with high frequency seismic waves from large earthquakes. Its ultimate goal is to predict strong ground motion from the basic understanding of fault mechanics and seismic wave propagation in the Earth.
	Seminar of Earthquake Hazard Assessment A		Discussion, presentation and practice for the topic of Earthquake Hazard Assessment
	Earthquake Risk Assessment	Structural Reliability*	The lecture covers 1) Introduction to reliability concept, 2) Probability of failure as a measure for the safety degree, 3) Extreme value distributions as probability model for load intensity, 4) Load and resistance factor format based on the second moment reliability and 5) Target safety degree due to the optimum reliability.
		System Identification in Vibration Analysis	This subject introduces several system identification methods to determine structural characteristics such as natural periods and damping ratios from measuring data of buildings.
		Seismic Evaluation and Rehabilitation	Seismic capacity evaluation and seismic rehabilitation (retrofit) of existing buildings are introduced with emphasis on our practice after the 1995 Hyogoken-Nanbu Earthquake (Kobe Earthquake).
		Urban Earthquake Disaster Mitigation System*	Mechanism and various impacts of earthquake damage in urban areas are analyzed considering the problems generated by urbanization of the area. Based upon the analysis above, issues for establishing proper countermeasures for disaster mitigation are discussed.
		Post-Earthquake Quick Inspection, Damage Evaluation and Rehabilitation	Post-earthquake quick inspection for risk evaluation of secondary disasters is introduced with basic concept of evaluation methods in Japan, U.S. and Europe, and detail procedure and criteria of Japanese method including application example in Turkey. Post-earthquake damage evaluation for decision of rehabilitation strategy, and rehabilitation technique examples for damaged buildings are also introduced.
		Seminar of International Disaster Prevention	Observation Visit to Life Safety Learning Center, Edo-Tokyo Museum etc.
	Seminar of Earthquake Risk Assessment		Discussion, presentation and practice for the topic of Earthquake Risk Assessment
Special Topics	Tsunami Load and Structural Design of Tsunami Shelter*		The lecture covers 1) Observed Buildings Damage Pattern by Tsunami in Great East Japan Earthquake, 2) Introduction of Design Tsunami Loads in Past Guidelines and New Design Guideline, and 3) A Study on Design Flow and an Example of Tsunami Shelters.
	Lessons from the Great East Japan Earthquake of March 11, 2011*		Disaster prevention for millennium earthquakes-tsunamis and characteristics of the 2011 Great East Japan earthquake – tsunami are introduced.
	Japanese ODA Policy and Development Assistance Related with Disaster Management		Japanese ODA policy and implementation and the international trend of development assistance related with disaster management activities including poverty and gender issues are explained.
	How to Write a Scientific Report		Lecture for effective writing research reports (papers) will be given by an English native editor.
	Study Trip		Study trip to western part of Japan (Kansai) etc.

Case Study	Practice for Earthquake Disaster – Recovery Management Policy I, II & III	Colloquium	Three colloquiums are planned: 1) for seismic codes and past seismic damage of buildings in the countries of each participant, 2) for the practice of reading scientific papers, and 3) for explaining the plan of individual study.
		Study Trip	Study trip to northern part of Japan (Tohoku) for a week .
	Visiting various types of structures		Participants discuss earthquake disaster countermeasures for various structures at the visiting sites.
Master Thesis Seminar.	Master Thesis Seminar.		During the master thesis seminar period, each participant makes a research on a specific subject and writes a paper under the direction of an instructor. The subject is selected in the list shown in ANNEX I.
Disaster Management Policy (for Master Program)	Disaster Management Policies A: from Regional and Infrastructure Aspect		This course deals with the various aspects of disaster management policies from the viewpoint of infrastructure development. It emphasizes understanding the mechanism of natural disasters and measures against it. The course consists of four parts: I) Introductory lecture to overlook disaster management policies II) Lectures in specialized fields on practical measures against natural disasters III) Site-visiting in central Tokyo IV) Presentations by students and overall discussions The 3rd and 4th are jointly managed with DMP(B).
	Disaster Management Policies B: from Urban and Community Aspect		This course aims to provide a broad understanding of disaster risk management policies related to urban, housing and community aspects. It emphasizes application of appropriate and practical measures, reflecting social, economic and environmental conditions of each country. This course also attempts to discuss the following issues: - Basic issues of the disaster management policies - Lessons from the past large disasters in the world - Urban Disaster risk management policy in Japan - Politics and regulations to secure building safety - Site-visiting in central Tokyo, presentations by students and overall discussions are jointly managed with DMP(A).

*: included in the syllabus of the Master Thesis Seminar.

T-Group (Tsunami Disaster Mitigation Group)

Category	Title	Subtitle	Contents
Orientation	Orientation	Overview of Earthquake, Tsunami, and Disasters	Introductory lectures for seismology and tsunami are given by staff members of IISEE. Basic concepts and general scope of seismology, earthquake phenomena, strong motion study, seismic hazard and risk, and tsunami, etc. are described.
		Tsunami and Earthquakes*	Basic concept and overview of tsunamis, including tsunami generation, propagation and tsunami warning and hazard reduction systems.
		Ethics and Literacy for Scientific Studies	We provide explanations on subjects to learn about research ethics and literacy required for scientific studies.
Basic Subjects Related with Earthquake and Disasters	Information Technology Related with Earthquakes and Disasters	Computer	Practices on FORTRAN programming for scientific computing and on UNIX and GMT are given using PC and Linux server. The basic of Python 3 programming is provided.
		Theory of Seismic Waves	Basic expressions for strain and stress relations are induced from the fundamental concept of the property of elasticity. Mathematical background of the theory of elasticity is discussed from the standpoint of specific problems such as equilibrium conditions, strain energy and transmissions of elastic waves. Reflection and refraction of plane waves are explained. P and S waves velocity distribution is discussed.
		Surface Waves	Crust and upper mantle structure inferred from surface wave analysis, including its analogies with tsunamis (surface gravity waves in the ocean) is explained.
	Earthquake Phenomenology	Earthquake Observation (1), (2)*	Basic theory of electro-magnetic seismometer is explained. A method for calibration of conventional type of short period seismometer is presented. Practical training for the calibration is also planned. Data acquisition and seismic telemetry systems are explained.
		Local Earthquake Analyses (1)	Analyses of seismograms obtained by local networks, e. g., Wadati diagram, particle motion, apparent velocity, hypocenter determination, and magnitude.
		Local Earthquake Analyses (2) *	Practical analyses of seismograms obtained by local network, e.g., Earthquake location for a homogeneous medium, location errors, iterative weighting, and application.
		Teleseismic Phases and Magnitudes	Teleseismic phases and typical magnitude scales are explained. The Earth's normal modes and their relations to seismic phases are introduced.
		Earthquake Early Warning (1)	The methodologies of Earthquake Early Warning (EEW) are explained, and then actual operation of the system is discussed. Experience of actual operation of nationwide EEW system by the Japan Meteorological Agency is also given.
		Earthquake Early Warning (2)*	This lecture introduces the general concept of an earthquake early warning (EEW) system and its practical examples. This lecture also has an exercise using PC. We will determine the P-wave arrival time and compute amplitude and period parameters which will be used for EEW system.

		Seismicity and Statistics*	This course aims to give a basic introduction to statistical techniques that are useful in the study of seismicity. Several statistical techniques and models are introduced and discussed alongside the well-known empirical laws. This course also provides hands-on practical sessions using computer software to analyze seismic activity data.
		Crust and Upper Mantle Structure	Crust and upper mantle structure inferred from explosion seismic and surface methods are explained.
		Crustal Deformation	Introductory course of crustal deformation including geodetic survey and continuous measurement with special references to the problems on modeling of earthquake and volcanic events and earthquake forecasting.
	Seminar of Basic Seismology		Discussion, presentation and practice for the topics of Basic Seismology.
Advanced Subjects Related with Earthquake and Disasters	Earthquake Circumstance	Earthquake Generation and Forecasting (1)	Earthquake dynamics and scaling laws are explained. Earthquake preparation processes and research on short-term prediction are introduced.
		Earthquake Generation and Forecasting (2)*	Earthquake cycles and long- and intermediate-term prediction are introduced.
		Mathematics for Seismology	Basic concepts and technique of applied mathematics used often in the field of seismology are explained. Subjects include linear differential equations, Fourier analysis, matrix algebra and vector analysis. Practice of applied mathematics is also given.
		Focal Mechanism	Basic knowledge and practice for determination of focal mechanism by P-wave first motion method.
		Moment Tensor Analysis	Basic knowledge and practice for determination of focal mechanism by moment tensor inversion method.
		Earthquake and Plate Tectonics*	The basic concept of plate tectonics is presented. Methods to obtain plate motions are described.
		Earthquake Source Process*	The main purpose of this lecture is to provide you with basic earthquake source models and conception of earthquake source process, showing techniques to synthesize seismic waves from the source models and to determine the parameters that can describe earthquake source process.
	Theory of Tsunami	Tsunami Simulation*	Hands-on practices to calculate tsunami waveforms and tsunami height are given by using Windows PC. In order to help the interpretation of simulation results, visualization technique using mapping software are also introduced.
		Data Processing	Theory and practice of the least squares method used for seismological analyses and those of Discrete Fourier transform, and digital filter are introduced.
		Practice for Theory of Tsunami	Specific tasks and subjects on Practice for Theory of Tsunami are given considering interests and backgrounds of participants.
		Tsunami Magnitude and Catalogue*	History of large tsunamis in the world is explained and discussed. Existing tsunami catalogues are also studied. The size of tsunami is described by various magnitude scales. Mechanisms of tsunami earthquakes are also learned. Various tsunami generated by non-earthquake origins, such as landslides or volcanic activities, are also studied.
		Mathematics for Tsunami	Practices on applied mathematics used often in the field of tsunami are given.
		Hydrodynamics for Tsunami	The basic equation of fluid dynamics, general ocean wave theory, tsunami generation theory, and non-linear wave theory of tsunamis are explained.

		Tsunami Source	To calculate travel time of tsunami some computer practices are given. Basic concept to estimate a tsunami source area from arrival times of observed tsunami is explained. Hands-on practices to estimate tsunami source are also given.
		Geology for Tsunami*	Basic techniques for detecting geological and geomorphological evidences of paleo-tsunami and paleo-earthquake are explained. Subjects include coastal sedimentology, coastal geomorphology and Quaternary geochronology.
Tsunami Hazard and Risk Assessment	Tsunami Hazard Assessment	Tsunami Disaster Prevention Administration	Tsunami disaster prevention schemes by local government are introduced. We visit several cities along the Sanriku coast and learn about governmental approaches for tsunami disaster prevention.
		Lessons from the Great East Japan Earthquake of March 11, 2011*	Disaster prevention for millennium earthquakes-tsunamis and characteristics of the 2011 Great East Japan earthquake – tsunami are introduced.
		Tsunami Disaster Mitigation Policy and Risk Management in Japan	A visit to the Port and Harbor Bureau to study tsunami disaster mitigation policy and risk management in Japan is conducted.
		Introduction of Tsunami Disaster Mitigation*	Various features of tsunamis are explained with hydrodynamic principles. Many kinds of tsunami disasters are shown by examples in the past, and possible disasters in the future are also estimated.
		Tsunami Hazard Assessment and the Sendai Framework for Disaster Risk Reduction*	Basics on the tsunami hazards assessment is introduced by reviewing historical and recent tsunami hazard/disaster and providing the idea of the risk analysis. Records of tsunamis in the documentation and geological evidences are examined to estimate the frequency.
		Tsunami Damage Survey	Characteristics of tsunami damages are introduced through examples of post-tsunami survey results. Survey method is explained with the theory. After explanations for matters to be attended in field survey, survey exercise is conducted.
		Theory of Tsunami Propagation and Inundation Simulation	This class aims to understand the logic of source program of the TUNAMI (Tohoku University's Numerical Analysis Model for Investigation) code.
		Numerical Simulation of Tsunami Inundation and its Application*	A finite difference method for the long-wave model is explained. Simulation exercises for tsunami propagation and inundation are given.
		Tsunami Hazard Mapping, Evacuation Planning and Simulation	Basic concepts and outline of tsunami hazard map, method of making tsunami hazard map, use of tsunami hazard map. Overview of tsunami evacuation planning and tsunami evacuation simulation. Hands on concepts, definitions, steps and issues for tsunami evacuation planning. Review of methodologies used on tsunami evacuation simulation.
		Scenario Earthquakes	You learn a method for setting Scenario earthquakes for tsunami situation.
		Study Trip to Kansai	Study trip to western part of Japan.
		Education of Tsunami Disaster reduction and International Tsunami Warning System	UNESCO lecturer introduces educational activities for tsunami disaster reduction and international tsunami warning system.

	Tsunami Countermeasures	Tsunami Protection Facility	A field study, in which the tsunami protection facilities are observed, is included in the course. A field trip to observe the tsunami trace and to understand the damages due to tsunamis is also conducted along the Sanriku coast.
		Tsunami Damage and Reconstruction I and II	Observation of tsunami damage caused by the Great East Japan earthquake disaster and reconstruction process.
		Tsunami Observation	Sea level observation method and tide gauge data analysis are introduced. A tour to visit tide gauge station is also conducted.
		Tsunami Early Warning System and Dissemination	Outline of tsunami warning service and tsunami estimation are explained.
		Practice for Tsunami Countermeasures	Each participant has practices so that he/she can improve understanding on the subject "Tsunami Countermeasures." IISEE staff members decide specific tasks and subjects considering interests and backgrounds of participants.
		Tsunami Force and Tsunami Resistant Structure	Design formulas of tsunami force are introduced and some examples to computation of tsunami force are lectured. An experiment to evaluate the tsunami impulsive force is demonstrated during the course. As tsunami resistant structures, breakwaters and tidal barriers are shown as well as greenbelt techniques.
		Tsunami Deposit Survey	Observation of tsunami damage caused by the Great East Japan earthquake disaster and reconstruction process.
		Tsunami Load and Structural Design of Tsunami Shelter	Observation of buildings damage pattern by tsunami in the Great East Japan Earthquake. Introduction of design tsunami loads in past guidelines and new design guideline. A study on design flow and an example of Tsunami shelters.
		International Seminar for Disaster Management*	Observation Visit to Life Safety Learning Center, Edo-Tokyo Museum etc.
	Special Topics	Earthquake Geology*	Geological subjects related to earthquake prediction, hazard assessment and countermeasures.
		Study Tour of Earthquake Monitoring	Observation tour to the institutes that have notable activities in the field of Earthquake and Tsunami Science.
		Japanese ODA Policy and Development Assistance Related with Disaster Management	Japanese ODA policy and implementation and the international trend of development assistance related with disaster management activities including poverty and gender issues are explained.
		How to Write a Scientific Report	Lecture for effective writing research reports (papers) will be given by an English native editor.
Case Studies	Practice for Earthquake Disaster – Recovery Management Policy I & II	First, Second, and Third Colloquiums	Three colloquiums are planned: 1) for the report on the seismic observation and its results in the countries of each participant, 2) for the practice of reading scientific papers, and 3) for explaining the plan of individual study.
	Practice for Tsunami Disaster Mitigation Policy	Real Time Determination of Source Parameter	Real time determination of source parameters (local event) is introduced.
		Determination of Broadband Moment Magnitude	Broadband moment magnitude (Mwp) is a magnitude determined by processing of first arriving P-waves, and has been adopted by tsunami warning centers. First, this magnitude scale is explained in the lecture. Then, computer practices to determine this magnitude are provided.

		Study Tour of Earthquake Monitoring	Observation tour to the institutes that have notable activities in the field of Earthquake and Tsunami Science.
	Practice for Seminar of Tsunami Disaster Mitigation Policy		Practice for the topics of Tsunami Disaster Mitigation Policy.
Master Thesis Seminar.	Master Thesis Seminar.		During the master thesis seminar period, each participant makes a research on a specific subject and writes a paper under the direction of an instructor. The subject is selected in the list shown in ANNEX I.
Disaster Management Policy (for Master Program)	Disaster Management Policies A: from Regional and Infrastructure Aspect		This course deals with the various aspects of disaster management policies from the viewpoint of infrastructure development. It emphasizes understanding the mechanism of natural disasters and measures against it. The course consists of four parts: I) Introductory lecture to overlook disaster management policies II) Lectures in specialized fields on practical measures against natural disasters III) Site-visiting in central Tokyo IV) Presentations by students and overall discussions The 3rd and 4th are jointly managed with DMP(B).
	Disaster Management Policies B: from Urban and Community Aspect		This course aims to provide a broad understanding of disaster risk management policies related to urban, housing and community aspects. It emphasizes application of appropriate and practical measures, reflecting social, economic and environmental conditions of each country. This course also attempts to discuss the following issues: - Basic issues of the disaster management policies - Lessons from the past large disasters in the world - Urban Disaster risk management policy in Japan - Politics and regulations to secure building safety - Site-visiting in central Tokyo, presentations by students and overall discussions are jointly managed with DMP(A).

*: included in the syllabus of the Master Thesis Seminar.