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 Groups 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.
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.
		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 methods will be explained.
		Scattering and Attenuation	Stochastic modeling and measurement of small-scale heterogeneities and intrinsic attenuation of seismic waves in the crust will be explained.
	Earthquake Phenomenology	Local Earthquake Analyses	Analyses of seismograms obtained by local networks, e.g., Wadati diagram, particle motion, apparent velocity, hypocenter determination, and magnitude.
		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.
		Observation of Seismological Observatory	Observation of Matsushiro Seismological Observatory, Japan Meteorological Agency.
		Earthquake Early Warning	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.
		Seismicity and Statistics	Fundamental concepts on seismic activity and earthquake statistics including prediction-oriented method analysis.
		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 Prediction (1)	Earthquake dynamics and scaling laws are explained. Earthquake preparation processes and researches on short-term prediction are introduced.
		Earthquake Generation and Prediction (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	Basic models and conceptions of earthquake source processes are provided. The following three subjects: 1) how to describe an earthquake source mathematically, 2) how to synthesize body waves generated from the source, 3) how to determine the model parameters are explained.
	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 Earth Sciences.
		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.
	Seminar of Applied Seismology		Discussion, presentation and practice for the topics of Applied Seismology
Earthquake Hazard and Risk Assessment	Earthquake Hazard Assessment	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 will be 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 Risk Assessment	Practice for Earthquake Risk Assessment	Participation in international conferences, field trips and/or special lectures related to the earthquake risk assessment.
		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.
		Simulation of Seismic Ground Motion	Method to estimate the strong ground motion at the engineering bedrock based on the empirical formulas is explained.
		Microtremor Observation(2)	Field practice of microtremor array observation
		Geophysical Prospecting	Principles of seismic refraction and reflection and their applications to the real field are discussed. Field Practice is given.
		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.
	Seminar of Earthquake Disaster-Recovery Management		Discussion, presentation and practice for the topics of Earthquake Disaster-Recovery Management
Disaster-Recovery Management Policy	Disaster Management Policies A: from Regional and Infrastructure Aspect.		This lecture deals with the various aspects of disaster management policies from the viewpoint of nation-wide or wide range regional and Infrastructure development. The lecture consists of five parts: 1) bird-view lectures to look over the philosophies and principles of disaster management policies, 2) field-wise specialized lectures on practical measures against natural disasters, 3) two special lectures by Japan-representing outstanding lecturers, 4) an one day site-visiting in central Tokyo, and 5) presentations of student groups and overall discussions.
	Disaster Management Policies B: from Urban and Community Aspect		This lecture aims to provide a broad understanding of disaster risk management policies related to urban, housing and building aspects. It emphasizes application of appropriate and practical measures, reflecting social, economic and environmental conditions of each country.

	Disaster – Recovery Management and Development Assistance	Earthquake Observation	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
		Observation Visit for Dissemination for Earthquake Disaster-Recovery Management	Observation visit to the institutes related to disaster -recovery management.
		Japanese ODA Policy and Development Assistance Related with Disaster-Recovery Management	Japanese ODA policy and implementation and the international trend of development assistance related with disaster-recovery management activities including poverty and gender issues are explained.
		Seminar of Earthquake Disaster-Recovery Management Policy	Methodology and practice for Project Management Cycle and its facilitation techniques. Additionally, joint & mutual observation visits are planned for JICA course participants of IISEE and ICHARM.
Case Studies	Practice for Earthquake Disaster-Recovery Management Policy	Colloquium	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.
		Study trips	Study trip to north-eastern part of Japan (Tohoku) for a week and to western part of Japan (Kansai) for a week.
	Practice for Seminar of Earthquake Disaster-Recovery Management		Practice for the topics of Earthquake Disaster-Recovery Management
Individual Study	Individual Study		During individual study 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 "II. Description, 10.Expected Module Output and Contents".

E- Group (Earthquake Engineering Group)

Category	Title	Subtitle	Contents
Orientation	Orientation	Guidance	An introduction to the training program for Earthquake Engineering Group will be given through Guidance and an introductory lecture.
		Introduction to Earthquake Engineering	Basic concepts and damage aspects by past earthquakes in Japan, as an introductory lecture for engineering course.
		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 I, II & III	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. 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	1) Basic concepts of finite element method 2) Procedures for static linear analysis 3) Formulation of some elements' matrices 4) Example programs
		Finite Element Method II	1) Aims and Material Modeling 2) Cracks width analysis 3) Dynamic Analyses of RC Frames
		Dynamic Aseismic Design	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.
		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 will give the basis for understanding dynamic behaviors of soil and foundation.
		Tsunami Load and Structural Design of Tsunami Shelter	(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
	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 provide 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 using SDOF systems with various kind of hysteresis models and introduction of some applications using inelastic earthquake response analyses. 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.
		Soil Test and Survey II	Some common methods on the field survey of soil deposits and laboratory tests are introduced.

		Effect of Surface Geology on Seismic Motion	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.
	Seminar of Structure Analysis		Discussion, presentation and practice for the topic of Structural Analysis
Advanced Subjects Related with Earthquake and Disasters	Seismic Design	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 I & II	Outline of the design procedure for steel building structures in Japan is explained.
		Masonry Structures I	The lecture covers an introduction to Performance of Masonry-based Structures and seismic design. The lecture covers an introduction to structural performance and seismic design of Confined Masonry structures, which has been studied as a research projects in BRI. It also includes housing construction conditions in the Third World Countries and their comparison with Japan's.
		Masonry Structures II	First, the concept and the method of seismic design of masonry structures will be 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” will be introduced as part of the Japanese codes. Second, the seismic behavior of masonry buildings will be explained from the aspects of “seismic evaluation of existing masonry buildings” and the “modeling of restoring force characteristics of masonry wall members”.
		Structural Testing I, II & III	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.

		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.
		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.
		Port & Harbor Structures and Tsunami Engineering	Earthquake resistant design for port and harbor structures is explained with some examples of actual earthquake damage.
		Dam Structures	The types of dams including concrete arch, gravity, and embankment dams are explained first. Next, design concepts of each type are given. The design of dams to resist earthquakes is discussed with the performance of dams during earthquakes, dynamic properties of dam materials, and analysis. Particularly, behaviors of dams during the 1995 Hyogoken-Nanbu Earthquake (Kobe Earthquake) and the 2000 Western Tottori Prefecture Earthquake are explained.
		Underground Structures	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 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.
		Urban Earthquake Disaster Mitigation System	Mechanism and various impacts of earthquake damage in urban areas will be analyzed considering the problems generated by urbanization of the area. Based upon the analysis above, issues for establishing proper countermeasures for disaster mitigation will be discussed.
	Seismic Evaluation and Retrofitting	Seismic Design Codes I & II	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.
		Earthquake Resistant Limit State Design I & II	The lecture covers an introduction to fundamental energy input concept which gives better understanding of the dynamic behavior of buildings.
		Seismic Evaluation and Rehabilitation: buildings	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) Inspection and evaluation of earthquake damage to buildings and post-earthquake countermeasures for damaged buildings are also introduced.

		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.
		Seismic Isolation	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.
		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.
		Structural Reliability	Introduction to reliability concept. Probability of failure as a measure for the safety degree. Extreme value distributions as probability model for load intensity. Load and resistance factor format based on the second moment reliability. Target safety degree due to the optimum reliability.
		Structural Response Control	Basic theory on structural seismic response control and its practical applications in Japan
	Seminar of Seismic Design, Seismic Evaluation and Retrofitting		Discussion, presentation and practice for the topic of Seismic Design, Seismic Evaluation and Retrofitting
Earthquake Hazard and Risk Assessment	Earthquake Hazard Assessment	Soil Test and Survey I	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.
	Earthquake Risk Assessme	Practice for Earthquake Risk Assessment	Topics related on Earthquake Risk Assessment for buildings are given through lectures and observation visits.

	nt	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.
		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 will be introduced.
		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 will be conducted.
		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.
	Seminar of Earthquake Disaster-Recovery Management		Discussion, presentation and practice for the topics of Earthquake Disaster-Recovery Management
Disaster-Recovery Management Policy	Disaster Management Policies A: from Regional and Infrastructure Aspect.		This lecture deals with the various aspects of disaster management policies from the viewpoint of nation-wide or wide range regional and Infrastructure development. The lecture consists of five parts: 1) bird-view lectures to look over the philosophies and principles of disaster management policies, 2) field-wise specialized lectures on practical measures against natural disasters, 3) two special lectures by Japan-representing outstanding lecturers, 4) an one day site-visiting in central Tokyo, and 5) presentations of student groups and overall discussions.
	Disaster Management Policies B: from Urban and Building Aspect		This lecture aims to provide a broad understanding of disaster risk management policies related to urban, housing and building aspects. It emphasizes application of appropriate and practical measures, reflecting social, economic and environmental conditions of each country.
	Dissemination for Earthquake Disaster Mitigation	Dissemination for Earthquake Disaster –Recovery Management	Dissemination process for Earthquake Disaster –Recovery Management in Japan is explained through observation visits.
		Japanese ODA Policy and Development Assistance Related with Disaster-Recovery Management	Japanese ODA policy and implementation and the international trend of development assistance related with disaster-recovery management activities including poverty and gender issues are explained.
		Project Cycle Management for Disaster –Recovery Management	Methodology and practice for Project Management Cycle and its facilitation techniques.
		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.

		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.
	Seminar of Earthquake Disaster –Recovery Management Policy		Discussion, presentation and practice for the topics of Earthquake Disaster –Recovery Management Policy
Case Study	Practice for Earthquake Disaster Mitigation Policy	Colloquium	Three colloquiums are planned: 1) for the report on the seismic observation and/or seismic codes in the countries of each participant, 2) for the practice of reading scientific papers, and, 3) for explaining the plan of individual study.
		Study Trips	Study trip to northern part of Japan (Tohoku) for a week and to western part of Japan (Kansai) for a week.
	Practice for Seminar of Earthquake Disaster-Recovery Management		Practice for the topics of Earthquake Disaster-Recovery Management
Individual Study			During individual study 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 "II. Description, 10.Expected Module Output and Contents".

T- Group (Tsunami Group)

Category	Title	Subtitle	Contents
Orientation	Orientation	Overview of Earthquake, Tsunami, and Disasters	Introductory lectures for Seismology and Tsunami Groups 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.
Basic Subjects Related with Earthquake and Disasters	Information Technology Related with Earthquake and Disasters	Computer	Practices on FORTRAN programming for scientific computing and on UNIX and GMT are given using PC.
		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 methods will be explained.
	Earthquake Phenomenology	Local Earthquake Analyses	Analyses of seismograms obtained by local networks, e. g., Wadati diagram, particle motion, apparent velocity, hypocenter determination, and magnitude.
		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.
		Observation of Seismological Observatory	Observation of Matsushiro Seismological Observatory, Japan Meteorological Agency.
		Earthquake Early Warning	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.
		Seismicity and Statistics	Fundamental concepts on seismic activity and earthquake statistics including prediction-oriented method analysis.
		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 Prediction (1)	Earthquake dynamics and scaling laws are explained. Earthquake preparation processes and researches on short-term prediction are introduced.
		Earthquake Generation and Prediction (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	Basic models and conceptions of earthquake source processes are provided. The following three subjects: 1) how to describe an earthquake source mathematically, 2) how to synthesize body waves generated from the source, 3) how to determine the model parameters are explained.
	Theory of Tsunami	Tsunami Simulation	Hands-on practices to calculate tsunami waveforms and tsunami height will be given by using Linux WS and 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 Generation and Propagation	Tsunami generation from earthquake fault motion and tsunami propagation: Both forward and inverse modelings are explained.
		Tsunami Source	To calculate travel time of tsunami some computer practices will be given. Basic concept to estimate a tsunami source area from arrival times of observed tsunami is explained. Hands-on practices to estimate tsunami source will be also given.
		Geology for Tsunami	Basic techniques for detecting geological and geomorphological evidences of paleo-tsunami and paleo-earthquake are explained. Subjects include coastal sedimentlogy, coastal geomorphology and Quaternary geochronology.
Tsunami Hazard and Risk Assessment	Tsunami Hazard Assessment	Tsunami Hazard Map	Basic concepts and outline of tsunami hazard map, method of making tsunami hazard map, use of tsunami hazard map and tsunami countermeasures in river and coastal zone in Japan are explained.

		Tsunami Disaster Prevention Administration	Tsunami disaster prevention schemes by local government are introduced. We will visit Kesen-numa city 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 Cabinet of Japan and 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	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 TUNAMI-N1 and N2 (Linear and Non-linear model of tsunami propagation and run-up).
		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 Evacuation Planning and Simulation	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 will learn a method for setting Scenario earthquakes for tsunami situation.
	Tsunami Countermeasures	Tsunami Protection Facility	A field study, in which the tsunami protection facilities will be observed, is included in the course. A field trip to observe the tsunami trace and to understand the damages due to tsunamis will be 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 tidal data analysis are introduced. Tidal station tour 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	Observe buildings damage pattern by tsunami in 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.
	Special Topics	Study Tour of Earthquake Monitoring	Observation tour to the institutes that have notable activities in the field of Earth Sciences.

Disaster-Recovery Management Policy	Disaster Management Policies A: from Regional and Infrastructure Aspect.		This lecture deals with the various aspects of disaster management policies from the viewpoint of nation-wide or wide range regional and Infrastructure development. The course consists of five parts: 1) bird-view lectures to look over the philosophies and principles of disaster management policies, 2) field-wise specialized lectures on practical measures against natural disasters, 3) two special lectures by Japan-representing outstanding lecturers, 4) an one day site-visiting in central Tokyo, and 5) presentations of student groups and overall discussions.
	Disaster Management Policies B: from Urban and Building Aspect		This lecture aims to provide a broad understanding of disaster risk management policies related to urban, housing and building aspects. It emphasizes application of appropriate and practical measures, reflecting social, economic and environmental conditions of each country.
	Disaster – Recovery Management and Development Assistance	Earthquake Observation	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 will be explained.
		Japanese ODA Policy and Development Assistance Related with Disaster-Recovery Management	Japanese ODA policy and implementation and the international trend of development assistance related with disaster-recovery management activities including poverty and gender issues are explained.
		Seminar of Earthquake Disaster-Recovery Management Policy	Methodology and practice for Project Management Cycle and its facilitation techniques. Additionally, joint & mutual observation visits are planned for the JICA course participants of IISEE and ICHARM.
Case Studies	Practice for Earthquake Disaster-Recovery Management Policy I and 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	Observation of Seismological Observatory	Inspection of the Matsushiro Seismological Observatory, Japan Meteorological Agency.
		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 Trips	Study trip to northern part of Japan (Tohoku) for a week and to western part of Japan (Kansai) for a week.
	Practice for Seminar of Tsunami Disaster Mitigation Policy		Practice for the topics of Tsunami Disaster Mitigation Policy.
Individual Study	Individual Study		During individual study 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 "II. Description, 10.Expected Module Output and Contents".