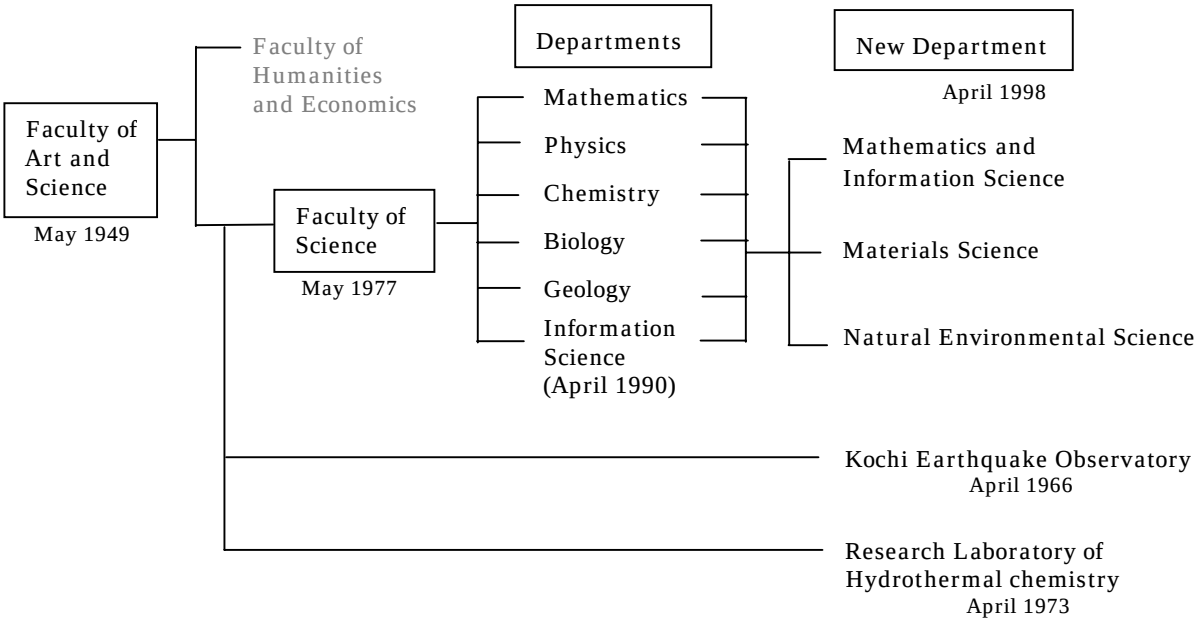
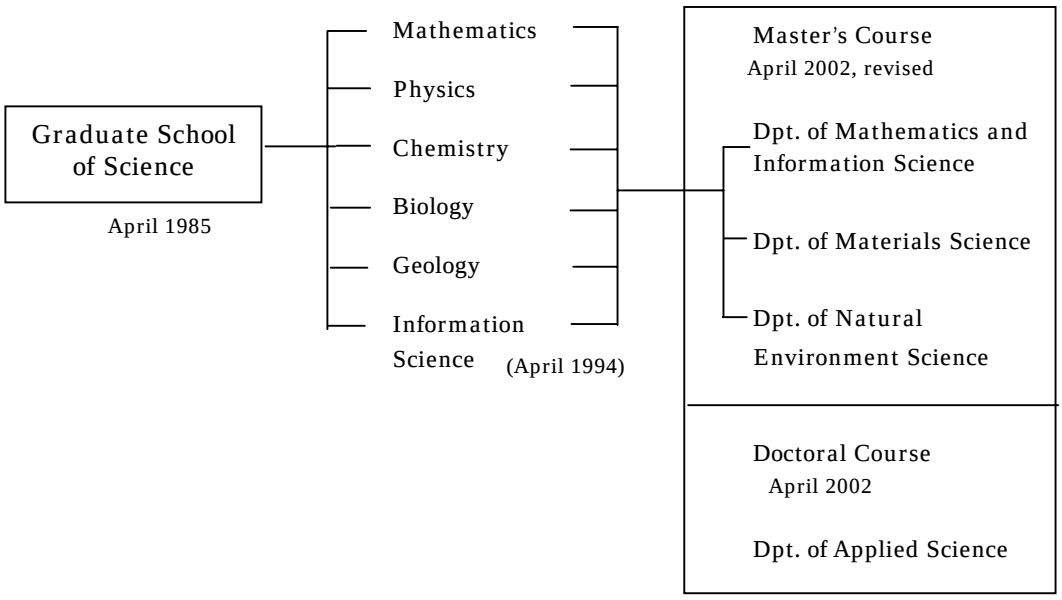
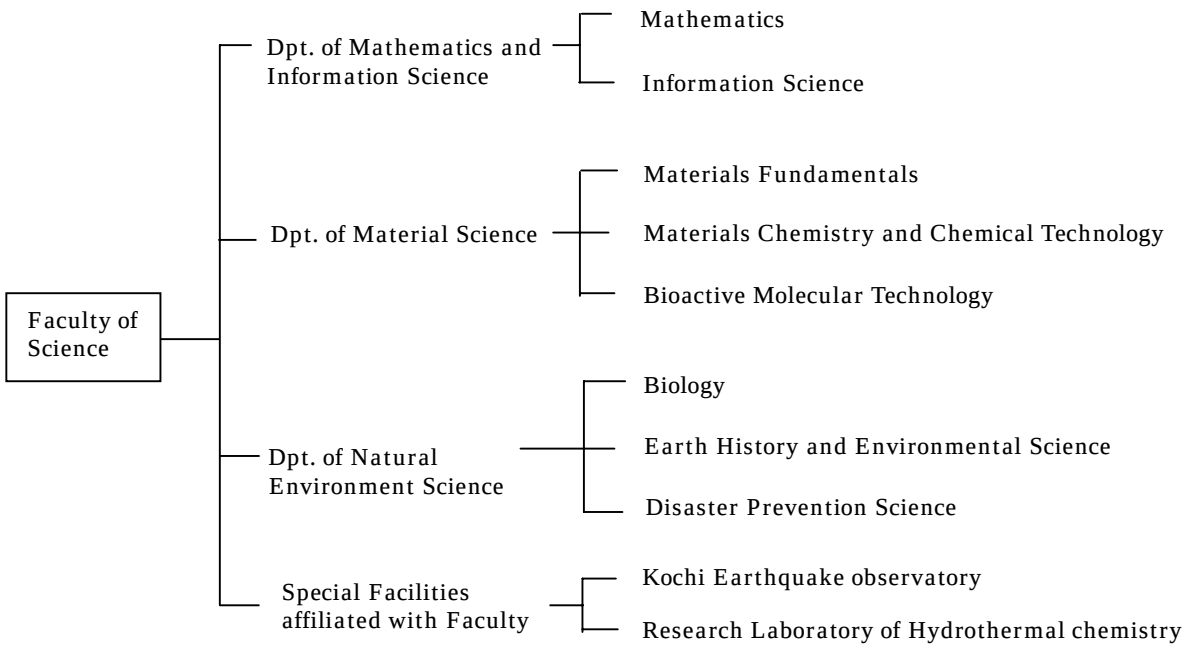
Historical Outline

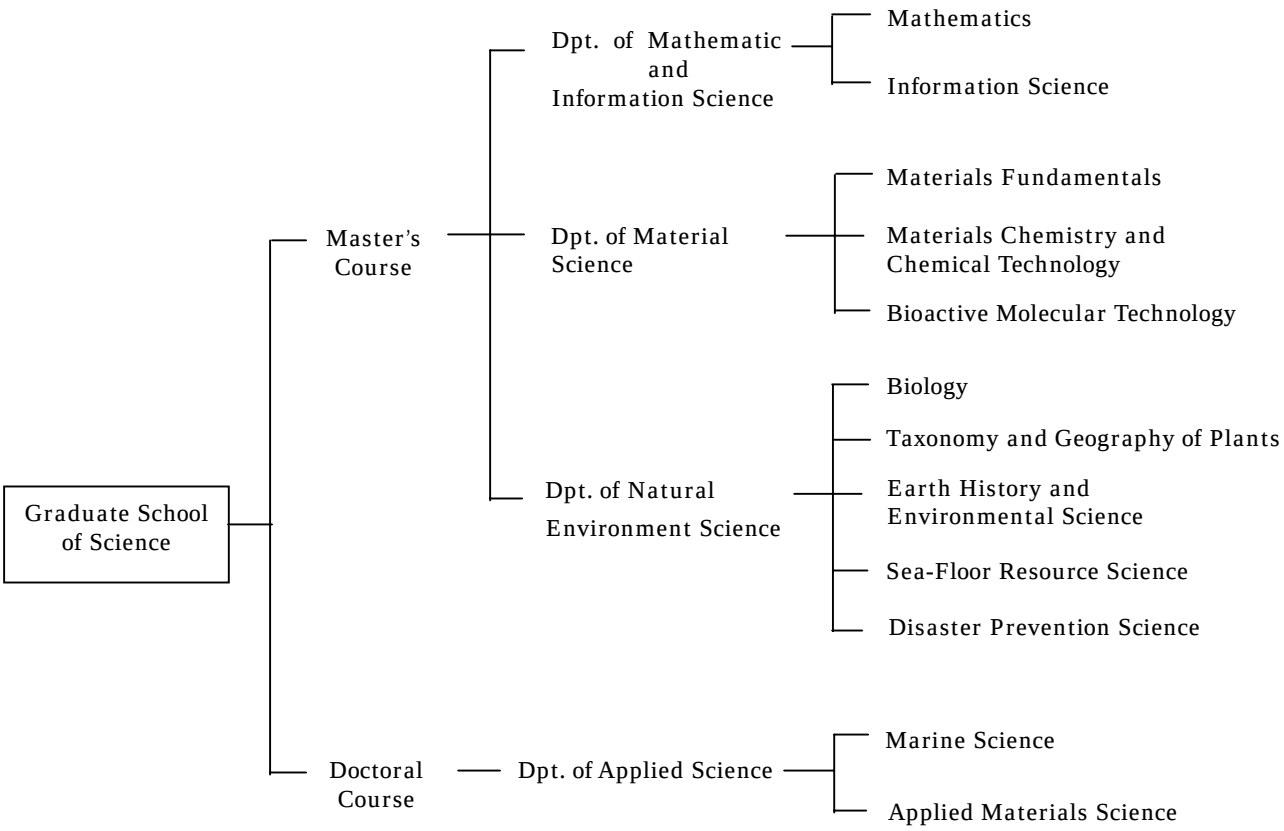


Majors



Facilities


Faculty of Science
Dpt. of Mathematics and Information Science
Mathematics
Information Science
Dpt. of Material Science
Materials Fundamentals
Materials Chemistry and Chemical Technology
Bioactive Molecular Technology
Dpt. of Natural Environment Science
Biology
Earth History and Environmental Science
Disaster Prevention Science
Special Facilities affiliated with Faculty
Kochi Earthquake observatory
Research Laboratory of Hydrothermal chemistry


Graduate School of Science
Master's Course
Dpt. of Mathematic and Information Science
Mathematics
Information Science
Dpt. of Material Science
Materials Fundamentals
Materials Chemistry and Chemical Technology
Bioactive Molecular Technology
Dpt. of Natural Environment Science
Biology
Taxonomy and Geography of Plants
Earth History and Environmental Science
Sea-Floor Resource Science
Disaster Prevention Science
Doctoral Course
Dpt. of Applied Science
Marine Science
Applied Materials Science

a. Research Guidance

(1) System for research instruction

Each student of the doctor course will have one Principal Supervisor (Shu-Shidokyoin) and two Co-Supervisors (Fuku-Shidokyoin). One of the Co-Supervisors should be selected from the Optional Fields. This system would enable the student not only to obtain advice on the specialized field of research, but also to benefit from guidance on wider topics under the Optional Fields and thereby develop a broader vision and professional flexibility. Upon completion of the doctor course, the student will thus be equipped with capability and knowledge to pursue profession in a wider arena of academic, scientific, industrial or technological sectors.

Co-Supervisor A: shall be from the same field or closely related field of specialization of the Principal Supervisor.

Co-supervisor B: shall be chosen from a field of specialty that is different from those of the Principal Supervisor and Co-Supervisor A.

Role of Research Supervisors

 # Principal Supervisor (Shu-Shidokyoin)

- The Principal Supervisor shall hold discussions with the student and decide the theme of doctoral research.
- The Principal Supervisor shall also guide in formulating the research plan, special classes and the presentation of the first half year's study and research schedule, through discussions with the student.
- The Principal Supervisor shall collaborate with the Co-Supervisor A to teach and train the student on special experiments, special exercise, special seminar as well on the main theme of the thesis research.
- The Principal Supervisor shall extend all necessary guidance to the student during the tenure of the doctoral research and would also provide necessary guidelines to the student for the preparation of the doctor thesis. The Principal Supervisor shall also evaluate the ability of the student during the research tenure based on the performance, talent and research output of the student, and shall offer necessary advise on the appropriate career to be pursued in academic, industrial or technological sectors.

 # Co-supervisor A (Fuku-Shidokyoin A)

- Co-supervisor A shall co-work with the Principal Supervisor in guiding the student for doctoral research and related matters.
- In case the Principal Supervisor meets with any accident, or is indisposed otherwise, Co-Supervisor A shall take the position and role of the Principal Supervisor.
- Research guidance during regular office hours shall be performed jointly by the Principal Supervisor and Co-supervisor A.

 # Co-supervisor B (Fuku-Shidokyoin B)

- Co-Supervisor B shall obtain the progress of research work from the student in presence of the Principal Supervisor and Co-Supervisor A.
- Co-supervisor B shall advise the student from a point of view that is different from the main theme of research of the student, with a view to amplify, revise or broaden the knowledge and academic vision of the student.
- Co-supervisor B shall discuss with the Principal Supervisor and Co-Supervisor A regularly about the progress of work of the student so as ensure that the student develops a wider perspective in research and study.

(2) Subjects offered, objectives and mode of selection

The students are offered a number of subjects in order for them to secure the required grade points for successful completion of the doctor course.

** Special and Optional Subjects:*

The Special and Optional Subjects provides opportunity for the student to become exposed to specialized fields related to the main theme of research as well as optional fields so as to grain a wider knowledge and broader vision.

** Special Experiment:*

In order to enhance the technical capabilities of the student, special experiment is offered with opportunity to learn both theory and practical experimental techniques related to the student's field of specialty as well as related fields.

** Special Seminar:*

The aim of Special Seminar is to train the student to assemble current trends in research from literature and to prepare a special seminar on a topic that is different from, but broadly related to, his/her doctoral research work. The student shall then present the seminar talk in front of an evaluation committee.

** Special Exercise:*

Special Exercise comprises the compilation of current research trends in the field of the student's doctor research and to define the orientation of the student's own research/laboratory work with respect to the global scenario. The study thus compiled has to be presented in English in front of an evaluation committee.

** Thesis Research:*

Thesis Research incorporates the student's main research work related to doctor degree. The student should orient the research work towards gaining advanced knowledge in theoretical fields and in acquiring ample skills in technological sectors. As a rule the doctor students should publish the results from their research work in reputed international journals. They should also present their work in international conferences or in seminars/meetings of comparable level.

Credits required

Subject	Credits
Special and Optional Subjects Special Experiment Special Seminar Special Exercise	6 or more 4 2 2
Total	14 or more

Standard model for completion of doctor course

The Credits for Completion				
Chair	Compulsory Credits	Elective Credits		Total
		Credits Opened	Credits Required	
Marine Science Applied Materials Science	Special Experiment 4 Special Seminar 2 Special Exercise 2 ---------- Subtotal 8	54	6	14 or more

(Invited lecture is offered for the employed person.)

b. Requisites for Completion of Doctor Course and the Degree Conferred

• Course Ph.D. / D.Sc.:

The Degree of Doctor of Philosophy (Ph.D.) or Doctor of Science (D.Sc.) is to be conferred regularly upon students who have fulfilled all the requirements of, (a) cumulative studies and reserches for more then three years; (b)14 credits or more, of which six credits are from compulsory subjects; (c)necessary research instructions; (d)the approval of Doctor's thesis; and (e)the success in the final examination. Students who have achieved excellent researches can receive some privileges concerning the requirements mentioned above.

It should however, be noted that in exceptional cases where student fulfils all the requirements and exhibits brilliant performance with outstanding research achievements within a period of time that is shorter than the required three years, then the doctor degree may be conferred after completion of two years of regular course study.

• Thesis (Paper) Ph.D./D.Sc.

In exceptional cases, Ph.D. degree shall be awarded to outside candidates who are not regular students of the doctor course in the university. In such cases, an expert committee shall evaluate the thesis submitted by the candidate and only those meritorious works that compare in quality with the theses prepared by students of the regular doctor course shall be considered. After evaluation of the thesis, if the work is found suitable, the candidate shall be asked to appear for an open defense at the Kochi University in front of an expert committee, on successful completion of which the doctor degree shall be awarded.

• The doctoral thesis must be submitted to the Faculty committee, and will be judged.

• The degree conferred is usually Doctor of Philosophy (PhD)

(Hakushi-Rigaku／Hakushi-Gakujutsu).

c. Standard Schedule to Complete the Course

month / year	4	5	6	7	8	9	10	11	12	1	2	3
1st	← ——— Major Subject (2 credits ———→						← – Major Subject (2 credits –→					
	← ——— Optional Subject (2 credits ——→											
	← ——————— Special Experiment						(4 credits ——————————→					
	← ——————— Special Seminar						(2 credits ——————————→					
	← ——————— **Thesis Research**						———————————					
2nd										Pre-presentation for the Thesis (February)		
	← ——————— Special Exercise						(2 credits ——————————→					
	——————— **Thesis Research**						———————————					
3rd							Pre-examination for the Thesis (October)					
									Open Defense for the Thesis (January)			
										Final Examination (February)		
											Awarding Ph.D / D.Sc Degree	
	——————— **Thesis Research**						——————→					(late in March)

- ♦ Major Subject: The lectures of the specialized field to which each student belongs. Two credits compulsory, totally 4 or more credits required.
- ♦ Optional Subject: The lectures of other fields chosen from the doctoral course subjects. Two or more credits required.
- ♦ Special Experiment: Training and practice of experiments, and planning or designing connected with the specified research theme. Four or more credits required.
- ♦ Special Seminar: Each staff or group member offers special seminar in the respective field that corresponds to 2 credits per year.
- ♦ Special Exercise: This subject is offered for cultivating the ability to perform research connected with the Thesis Research. Two credits required.
- ♦ Thesis Research: Thesis research is offered by each staff member, and aims to train the student in performing research and to submit finally the doctoral thesis.

d. Contents of Research Fields

■ Chair of Marine Science

Research Field	Content
Submarine Resources	Exploration and recovery of unexploited submarine resources are to be achieved by integration of scientific and technological information concerning ocean floor and other submarine environments. This field offers an important and challenging frontier to be developed in the field of marine sciences for the future. The course is formulated under support and cooperation with Japan Marine Science Technology Center, a leading national research organization that promotes marine science and technology. This field is particularly programmed to learn and experience "in site observations" of submarine mineral resources and ecology and provides opportunities to interact with scientists and technologists who are engaged in tackling new frontiers in the field of marine sciences.
Marine Material Science	The origin of ocean floor and the processes in the deep crust are investigated under this field in terms of marine geology, petrochemistry, and tectonics, with a focus on the utilization of marine mineral resources. The academic and research pursuits under this field ultimately aim at understanding the processes of formation of marine resources including mineral resources. A multidisciplinary approach linking both earth science and material science, together with laboratory experimental techniques including hydothermal chemistry, provide powerful tools to model the formation process of marine resources.
Biodiversity	Preservation of biodiversity in every ecosystem is one of the most urgent current day problems that concern the future of mankind. Biodiversity Field deals with living things in both terrestrial and marine ecosystems including those in the deep-sea. From the point of view of biodiversity, these two ecosystems are not entirely distinct, and they define a continuous spectrum. The academic and research programs under this field focus on life at the molecular and cellular domain, species and individual level, and population and community sectors so as to elucidate the biodiversity on this planet based on evolutionary history of living beings and environmental changes.

■ Chair of Applied Materials Science

Research Field	Content
Hydrothermal and Inorganic Functional Science	This field offers academic and research programs on the preparation/structural transformation of inorganic materials in presence of high temperature and high pressure water. Systematic investigations on the search/utilization of mineral resources, structure determination/synthesis of functional complexes, and identification/quantitative analysis of intermediate active species are also performed, based on the formation, analysis and transformation of functions. Techniques for recycling of resources, waste management, and preparation of functional ceramics, catalysts, inorganic-organic complex materials, are developed.
Synthetic Organic Chemistry	This field aims to develop new methods for the synthesis of complex organic molecules and its application to natural product chemistry, organic functional material science, medical and pharmaceutical chemistry, and supramolecular science. It also focuses on the evaluation of physical property of organic functional materials and on the elucidation of reaction mechanisms. Special topics including the development of new molecular and asymmetric catalysts, unusual and distinctive synthetic techniques, and environmentally friendly methods are also dealt with.
Life and Information Sciences	This field covers research fields concerning the structure and function of genetic and non-genetic information in living organisms, the complex interactions between macromolecules, and the relation between life information and homotopy theoretical structure. It also deals with current topics such as the information database structure and knowledge discovery, the relationship between 3D structure and enzyme kinetics, and the involvement of genome diversity in the mode of life and reproduction.
Theory and Application of Quantum Functions of Matter	Correlation structures in the ground and excited states in quantum many-body systems such as condensed matters, and nuclear and hadronic matters are studied based on group theory and Lie algebraic method. Magnetism and super-conductivity in highly correlated many electron systems are investigated by NMR/ NQR method. Application of real quantum materials to quantum devises, quantum computer and quantum communication are performed. Moreover, studies on high performance computer architecture, organization and implementation, which form the core of technology in a highly information-oriented society, are also included. Integrating these methods, this field offers systematic academic and research pursuit on quantum functions of matter.

e. Doctor Course Subjects

No.	Subject	Credit	Remarks
1	Submarine Geological Resources	2	
2	Ocean Floor Sedimentology	2	
3	Comparative Economic Geology	2	
4	Theory of Mathematical Optimization	2	
5	Marine Geophysics	2	
6	Special Lecture on Formation of Ocean-floor	2	
7	Special Lecture on the Processes of Formation and Evolution of Earth's Crust	2	
8	Special Lecture on Ocean Floor Geodynamics	2	
9	Special Lecture on Dynamic Marine Benthic Environments	2	
10	Special Lecture on Paleoenvironmental Changes in the Ocean	2	
11	Current Topics of Systematic Ichthyology	2	
12	Current Topics of Molecular Physiology	2	
13	Current Topics of Marine Animal Ecology	2	
14	Special Lecture on Structural Coordination Chemistry	2	
15	Special Lecture for Applied Science of Hydrothermal Reactions	2	
16	Special Lecture on Analytical and Dynamic Solution Chemistry	2	
17	Advanced Topics in Organic Functional Materials	2	
18	Advanced Synthetic Organic Chemistry	2	
19	Organic Reaction Mechanisms	2	
20	Advanced Study on Genome Science	2	
21	Advanced Study on Space Structures	2	
22	Advanced Study on Proteome Science	2	
23	Distributed Information Systems	2	
24	Quantum Correlation Physics	2	
25	Lecture on Structures of Quantum Many Particle Systems	2	
26	Quantum Computing Devices	2	
27	High Performance Computer Organization	2	
28	Application of NMR to Magnetic Materials and Superconductors	2	
29	Special Experiment	4	Credit
30	Special Seminar	2	Credit
31	Special Exercise	2	Credit

■ Doctor Course Subjects and Faculty

Chair：Marine Science (including Cooperative Studies with Marine Science and Technology Center (JAMSTEC))		
Research Field : ***Submarine Resources***		
Subject	Content	Teacher
Submarine Geological Resources	Recent topics of submarine hydrothermal ore deposits and gas hydrate with particular reference to their modes of occurrence, petrochemistry and genesis.	Guest Prof. M. Kinoshita
Ocean Floor Sedimentology	Sedimentological implications of diversity and genesis of ocean floor sediments containing manganese nodules and cobalt crust.	Guest Prof. W. Azuma
Comparative Economic Geology	Comparison of continental and marine ore deposits in terms of genesis, reserve and economic potential for the future.	Prof. S. Higashi Prof. A. Usui
Theory of Mathematical Optimization	Mathematical programming, Markov decision processes and optimal stopping theory, and applications to resource allocations.	Prof. Y. Ohtsubo
Marine Geophysics	Advanced geophysical research and modern techniques to explore and recover submarine resources.	Guest Prof. T. Fujiwara
Research Field : ***Marine Material Science***		
Special Lecture on Formation of Ocean-floor	This lecture presents the tectonic relation between sub-marine volcanism and marine environment by evaluating ophiolite genesis and sub-marine hydrothermal activity.	Prof. H. Ishizuka
Special Lecture on the Processes of Formation and Evolution of Earth's Crust	This lecture presents the recent models on the formation and evolution of oceanic crust and continental crust. The role of global mantle convection and magmatism in the formation of oceanic and continental crust will be discussed.	Prof. M. Santosh
Special Lecture on Ocean Floor Geodynamics	Introduction to geodynamic processes on land and ocean in terms of global plate tectonics. Emphases are placed on modern research and technological advancement in geodesy and paleomagnetism.	Prof. K. Kodama Prof. T. Tabei
Special Lecture on Dynamic Marine Benthic Environments	Examples of paleoenvironmental changes up to the present, reconstructed from molluscan and other paleontologic information will be provided. Also future environmental changes will be discussed.	Prof. Y. Kondo
Special Lecture on Paleoenvironmental Changes in the Ocean	This course introduces oceanographic processes active at the Earth's surface and their relationships to most aspects of the Earth's overall environment from the past. The paleoceanographic processes including oceanic circulation, biogeochemical cycles and climate dynamics are examined based on the isotope geochemical evidence.	Associate Prof. M. Murayama
Research Field : ***Biodiversity***		
Current Topics of Systematic Ichthyology	Evolution and systematics of deep-sea demersal fishes and species composition of deep-sea animal communities, especially those in the hydrothermal vent fields of the world.	Prof. Y. Machida
Current Topics of Molecular Physiology	Characterization of receptor molecules for environmental signals and transduction mechanism of such signals leading to behavioral modification or cytodiffentiation of unicellular organisms.	Prof. T. Matsuoka
Current Topics of Marine Animal Ecology	Topics for research in biodiversity of marine invertebrates at various habitats from coastal waters to deep-sea bottoms and human impact on their biodiversity and community structures.	Associate Prof. N. Iwasaki

Chair: Applied Materials Science		
Research Field : ***Hydrothermal and Inorganic Functional Science***		
Subject	Content	Teacher
Special Lecture on Structural Coordination Chemistry	This lecture covers stereochemistry, isomerism, reactivity and preparation of the coordinated compounds. The important roles of the metal-metal, ligand-metal and ligand-ligand interactions are discussed.	Prof. T. Ama
Special Lecture for Applied Science of Hydrothermal Reactions	Inorganic material synthesis and recycling of resources by hydrothermal method, and application of hydrothermal reactions for waste management processes, are explained and discussed.	Prof. K. Yanagisawa Associate Prof. K. Kajiyoshi
Special Lecture on Analytical and Dynamic Solution Chemistry	Recent advancements of analytical and dynamic solution chemistry are discussed with focus on equilibriums and kinetics of inorganic, complex, and inorganic-organic reactions in aqueous and nonaqueous solutions.	Prof. M. Hojo
Research Field : ***Synthetic Organic Chemistry***		
Advanced Topics in Organic Functional Materials	The concept of the functional π-molecular materials is argued in terms of the synthetic strategies and guiding principles. The following organic materials will be mainly treated: stimu-response π-molecular compouds, artificial chemosensors, and functional dyes for electronic devices.	Prof. K. Yoshida
Advanced Synthetic Organic Chemistry	The purpose of organic synthesis is to assemble a given organic compound from readily available starting materials and reagents in the most efficient way. This lecture will be mainly concerned with the following topics: 1. new methods & reagents for organic synthesis, 2. catalytic asymmetric synthesis, 3. natural product synthesis.	Prof. H. Kotsuki
Advanced Organic Reaction Mechanisms	Discussion of organic reaction mechanisms in terms of linear free energy relationships and ab initio molecular orbital calculations. Topics include reaction rate, substituent effect, solvent effect, and calculations of intermediates and transition state structures.	Associate Prof. R. Fujiyama
Research Field : ***Life and Information Sciences***		
Advanced Study on Genome Science	Edition and integration of large scale information concerning genome DNA and cDNA. Relation between genomic information and mode of life and reproduction.	Prof. K. Kawamura
Advanced Study on Space Structures	Cohomology rings of Hopf spaces. Higher homotopies associated with associativity and commutativity of multiplications of Hopf spaces. Polyhedra representing the higher homotopies.	Prof. Y. Henmi
Advanced Study on Proteome Science	Recent progress in proteome research. Structure, function and evolution of proteins. Biological significance in enzyme isoforms. Relationship between 3D structure and enzyme kinetics.	Prof. T. Suzuki
Distributed Information Systems	Lectures focus on the principles used in the design of database systems and distributed systems. Topics include information integration, concurrency and distributed communication, and knowledge discovery in databases.	
Research Field : ***Theory and Application of Quantum Functions of Matter***		
Quantum Correlation Physics	From the viewpoint of Lie group theory, this lecture is given on mean-field solutions with spontaneous symmetry-breaking, resonances between different correlation structures, noticing symmetries of quantum many-body systems.	Prof. M. Iwasaki
Quantum Computing Devices	Comprehensive lecture on solid state devices that are in the kernel of quantum computing and quantum communications, as the human challenge to make a breakthrough free from the limit of sequential processing of the conventional IT systems.	Prof. H. Matsueda
High Performance Computer Organization	Lecture of high performance computer architecture, organization and implementation; core technology of highly information-oriented society.	Prof. S. Kuninobu
Application of NMR to Magnetic Materials and Superconductors	Magnetism and Superconductivity are manifestation of quantum effects of many electrons in Solid. NMR and NQR methods are presented to study quantum electronic state in magnetic materials and superconductors.	Prof. M. Matsumura
Lecture on Structures of Quantum Many-Particle Systems	Structures and dynamics of the nucleus and hadronic matter are presented on quantum chromodynamics and the effective models. The phase transition of the matter at finite temperature and density is also discussed.	Associate Prof. Y.Tsue

Formalities

1. Attendance in Lectures

Following the guideline given below, candidates are required to submit to the office an Attendance Card for each lecture, failing which the credits for the corresponding lectures shall not be approved.

① Attendance card should be filled-in using an ink pen or ballpoint pen.
② Candidates should carefully read through the instructions on the card.
③ For optional subjects, tentative titles shall be accepted. The attendance procedure for these are defined individually.
④ The candidates should enter their research subject, obtain the endorsement stamp of the Principal Supervisor and then submit to the office.
⑤ The deadline for submission is **April 28th (Thursday), 2005**.
⑥ The office for submission is the Center for Student Services, Graduate School office for Faculty of Science
⑦ Candidates can confirm the list of attendance through an automatic certificate machine.

2. Announcements to Students

Announcements and Notices to students are put on a notice board at the Graduate School of Science (near the Center for Student Services). Other announcements including those related to payment of fees and school fees and grant of fellowships shall be posted on the notice board at the Kyotsu-kyoiku (General Education) building No. 3. Research Faculty Members shall also post occasional announcements and the candidates are advised to check the notice boards regularly.

3. Certificates

The following certificates are issued at the Center for Student Services, Graduate School office for Faculty of Science.

① Identity Card
② Entitlement for Student Discount (automatic certificate machine)
③ Attendance Card
④ Student Status (automatic certificate machine)
⑤ Grade Card
⑥ Others

4. Other Applications

Candidates are advised to approach the Center for Student Services (Kyomu-Jisshyu) office for other applications or special certificates including those for leave of absence, termination of study, etc.