Special Subjects of the Department of Fusion Science

Field	Course Code	Subject	Credit	Content of subject	Instructor
Device system / Research operation / Plasma heating / Diagnostics / Plasma simulation / Particle simulation / Magneto hydrodynamic simulation	20DFS001**	Plasma Physics Ⅰ	2	Fundamentals to learn plasma physics are lectured. First of all, single charged particle motions, then plasma behavior as fluids are explained. In the latter half of the class, waves in plasma, and diffusion and resistance of a plasma are also explained. The concept of magnetic confinement fusion and recent fusion plasma research are also described.	Hiromi Takahishi Tomohiro Morisaki
	20DFS002**	Plasma Physics Ⅱ	2	For the students who have finished Plasma Physics I, advanced contents of fundamental physics concepts for understanding the characteristic of fusion plasmas which are necessary in the plasma research is described. Both aspects of the microscopic particle property and the macroscopic fluid property in the plasma behavior are explained. The contents are composed of motion of a charged particle in various electromagnetic fields, relations between the distribution function in velocity space and the plasma fluid description, magnetohydrodynamic equilibrium and stability, waves in plasmas, basic idea of transport and resistivity and so on.	Katsuji Ichiguchi Masayuki Yokoyama
	20DFS020**	Fundamentals of Plasma Experiment	2	The aim of the lecture is to learn error analysis for allowing the scientists to estimate how large his uncertainties are, and to help him to reduce them when necessary. The basics of plasma diagnosis are reviewed. The error analysis based on the mathematical statistics and the least-squares fitting as its application are studied. The normal distribution and other important distributions are treated.	Gen Motojima Masaki Osakabe
	20DFS021**	Advances in Plasma Science	2	The basic physics of plasma transport at the peripheral region and plasma-wall interaction in magnetically confined fusion devices are explained. Especially, the divertor system receives and should handle huge heat flux coming from main plasma. The lecture presents the history of the divertor development and critical issues for next step fusion devices. In addition, the basics of atomic and molecular processes applied in fusion and related plasma researches are given, including atomic and molecular physics. Kinetics of chemical reactions, and collisional-radiative model for spectroscopic diagnostics.	Izumi Murakami Masahiro Kobayashi
	20DFS022**	Fusion System Engineering	2	This lecture is an introduction to fusion engineering. Features and functions of fusion power plant systems and their subsystems such as superconducting magnets, heating devices, divertor, and blankets are reviewed. Concerning the magnets, properties of materials at low temperatures and superconductivity are reviewed, and their issues are discussed. In addition, technical issues of divertor and blankets for high heat flux and neutron irradiation are discussed.	Shinsaku Imagawa Kazuya Takahata
	20DFS023**	Fusion Reactor Materials	2	Theories of elasticity, plasticity, strengthening and radiation damage of materials are reviewed. Tensile testing is explained as a major examination for materials, leading to a lesson in evaluation procedures and analyses on the test results. Materials adopted for the ITER, and candidate materials promising for future demonstration (DEMO) reactors are introduced including key properties. Based on the gap of the neutron irradiation conditions and the operation temperatures between the ITER and DEMO reactors, the material properties should be improved are discussed with some examples of recent fusion materials development.	Takuya Nagasaka Masayuki Tokitani
	20DFS024**	Fundamentals of Simulation Science	2	Learn the basic methods of computer simulation, a powerful tool for investigating complex plasma phenomena. Concepts, basic equations, algorithms, typical simulations performed by practical programs, their visualizations, limitations and numerical errors are described for particle and fluid models commonly used in plasma simulations.	Refer to the Syllabus-AY2022 edition for detail.

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Device system / Research operation / Plasma heating / Diagnostics / Plasma simulation / Particle simulation / Magneto hydrodynamic simulation	20DFS025**	Mathematical Physics	2	Various methods of mathematical physics are used to treat complex physical systems such as plasmas in which diverse collective phenomena are produced by a huge number of charged particles interacting with each other through electromagnetic force. This lecture presents basic methods of mathematical physics based on functional analysis and probability theory. As examples of application, one learns plasma kinetic theory, fluid model, and transport theory.	Ryutaro Kanno Atsushi Ito
	10DFS001**	Scientific English Writing and Presentation at International Conferences	2	Because international collaboration is often required for the successful development of magnetic fusion energy, as seen in the case of ITER, the ability of communication in English is a ″prerequisite″ to be a successful research scientist. A series of lectures will provide students with the basic knowledge to write and present technical papers in English for international conferences, also with practice in reading technical literature and a with a review of relevant grammatical topics.	Byron Peterson
	90DFS001**	Fusion plasma science exercise ⅠA	2	Exercises of experimental, theoretical and simulation science are given by advisering professors and other teachers. Discussions on the processes and results of research are guided which are necessary to complete educational course.	All teachers
	90DFS002**	Fusion plasma science exercise ⅠB	2		
	90DFS003**	Fusion plasma science exercise ⅡA	2		
	90DFS004**	Fusion plasma science exercise ⅡB	2		
	90DFS005**	Fusion plasma science exercise ⅢA	2		
	90DFS006**	Fusion plasma science exercise ⅢB	2		
	90DFS007**	Fusion plasma science exercise ⅣA	2		
	90DFS008**	Fusion plasma science exercise ⅣB	2		
	90DFS009**	Fusion plasma science exercise ⅤA	2		
	90DFS010**	Fusion plasma science exercise ⅤB	2		
	90DFS011**	Fusion plasma science investigation ⅠA	2	Seminar is organized for small number of students on fusion plasma science. Basic scientific knowledge, intelligence and flexibility are trained for the basis of original research. Teachers in the same research field as students lead seminar as core members.	All teachers
	90DFS012**	Fusion plasma science investigation ⅠB	2		
	90DFS013**	Fusion plasma science investigation ⅡA	2		
	90DFS014**	Fusion plasma science investigation ⅡB	2		
	90DFS015**	Fusion plasma science investigation ⅢA	2		
	90DFS016**	Fusion plasma science investigation ⅢB	2		
	90DFS017**	Fusion plasma science investigation ⅣA	2		
	90DFS018**	Fusion plasma science investigation ⅣB	2		
	90DFS019**	Fusion plasma science investigation ⅤA	2		
	90DFS020**	Fusion plasma science investigation ⅤB	2		
	90DFS032**	Exercise of scientific paper analysis	2	To write academic papers, it is important to conduct excellent research, but in fact it alone is not enough. ″Method of research″ differs depending on each theme, but there is a common ″method of writing″ when summarizing results of research as an academic paper. Rather than merely listing the research results, a story from the intro to the conclusion is necessary. How to make this story will be explained as a ″way of writing″.	Katsumi Ida
	90DFS031**	Fusion plasma science seminar	2	Learn latest information on research activities by attending colloquiums on fusion plasma sciences. Improve students' ability of preparing and talking their presentations and learn techniques for making an excellent presentation. Study how to examine their own and others' researches on fusion plasma sciences by joining the discussions in the colloquiums.	All teachers

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Device system / Research operation / Plasma heating / Diagnostics / Plasma simulation / Particle simulation / Magneto hydrodynamic simulation	20DFS017**	Basic exercise on physics and engineering Ⅰ	2	This exercise program gives you the basic knowledge to start experimental research on fusion plasma science. The program provides lectures and practices on the most important technologies in (1) vacuum instruments, (2) electrical and optical signal measurement systems, and (3) high current / voltage power supply usage and design. This knowledge is useful for studying not only fusion plasmas such as LHD plasmas, but also basic laboratory plasmas.	All teachers
	20DFS018**	Basic exercise on physics and engineering Ⅱ	2	In this exercise program, the bases of the following techniques are given: – the handling of the radiation, which is necessary for safe experimental study in fusion experimental devices – the handling of the cryogenic system including the high pressure gas facility that is acquired for the superconducting coil and cryogenic system in fusion experimental devices. – the handling of facilities of material analyses and fabrications which are necessary for studies of plasma–wall interactions and the fusion engineering.	All teachers
	20DFS019**	Basic exercise on physics and engineering Ⅲ	2	This exercise program gives the basic knowledge of data processing, theoretical analyses, and numerical simulations which are required in plasma physics researches. In particular, data and image processes (visualizations), fundamentals of simulation studies for UNIX and Fortran programing, and applied mathematics such as vector analyses and complex analyses will be practiced.	All teachers

A two-digit number or letter will be entered to ** according to the semester or the lecturer in charge.