Special Subjects of the Department of Polar Science

Field	Course Code	Subject	Credit	Content of subject	Instructor
Polar Space and Upper Atmospheric Sciences	20DPS001**	Magnetospheric Physics	2	The Earth's magnetosphere—the area influenced by the magnetic field that surrounds the earth—is made up of regions with various characteristics, and it changes dynamically due to the effects of solar wind and the Earth's atmosphere. Various plasma physics phenomena occur in parts of this field, and studying the magnetosphere can reveal universal principles that help in understanding other celestial bodies with magnetic fields (e.g. Jupiter, the Sun). This subject is designed to provide general knowledge about the structure of the magnetosphere and the various phenomena that arise within it.	Akira Kadokura
	20DPS002**	Cosmic Electrodynamics	2	This lecture covers the electromagnetism of the cosmos, i.e. the large-scale magnetic fields that are transported bodily in the swirling plasma throughout the universe. The motion of charged partcles and some basic characteristics are also derived in some special magnetic field configurations such as dipole and shocks.	Ryuho Kataoka
	20DPS003**	Radar Aeronomy	2	This subject covers the principles of radar observation for surveying the middle atmosphere, thermosphere and ionosphere, as well as the physics of neutral and ionized atmospheres as revealed by such radar observations. IS radar, HF radar, MF radar, meteor radar and MST radar are specifically described.	Akira Sessai Yukimatu
	20DPS004**	Auroral Physics	2	Aurora is a bright enough natural emission as captured by naked eyes, which is caused by massive electron precipitation into the polar atmosphere, as a result of the interaction between the solar wind and terrestrial magnetism. This lecture covers the fundamntal mechanism and the predictability of a compound system of the solar wind, magnetosphere, and ionosphere, which is manifested in the shape, motion, and colors of aurora.	Ryuho Kataoka
	20DPS005**	Polar Plasma Wave Theory	2	In the ionosphere and magnetosphere of the polar regions, as well as in the solar winds that blow through interplanetary space, plasma waves of various modes are dynamically and repeatedly formed, propagated and extinguished. These waves play an essential role in regulating the physical characteristics and mass balance of each of these regions. This subject covers the basic characteristics of magnetohydrodynamic waves, electrostatic plasma waves and electromagnetic waves, as observed in geospace (the region of space near Earth), as well as methods of observing these waves.	Masaki Okada
	20DPS006**	Aeronomy	2	Our understanding of the structure and variation of the Earth's atmosphere as it extends from the surface of the earth to the outer reaches of the solar system has grown dramatically. Whereas observation was previously limited to geomagnetic observation at the Earth's surface and spectroscopic observation from the ground, advances in recent years have made possible remote sensing from spacecraft and from the ground, as well as direct and indirect measurements from satellites. This subject offers an overview of our current understanding of the structure of the Earth's atmosphere and various physical processes based on geoelectromagnetic phenomena.	Takuji Nakamura
	20DPS007**	Ionospheric physics	2	The ionosphere is created by the ionization of the neutral atoms and molecules of the atmosphere. The charged particles in this region are affected by numerous processes, including chemical reactions, plasma instabilities, diffusion and transportation via electric and magnetic fields. A knowledge of the processes is essential for an understanding of the behavior of ionosphere and ionospheric phenomena. In this lecture, students learn the basic physical and chemical processes occurring in the ionosphere, and also generation mechanisms of several ionospheric phenomena.	Yasunobu Ogawa
	20DPS008**	Fundamental physics on the upper-atmospheric waves	2	This subject systematically covers the fundamentals of aeronomic waves, along with atmospheric gravity waves, tidal waves and planetary waves, as well as the propagation, wave-mean flow interaction and observation of such waves.	Yoshihiro Tomikawa

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Polar Space and Upper Atmospheric Sciences	20DPS030**	Introduction of upper atmosphere physics	2	The polar regions are closely connecting to Earth's Geospace space. Geospace is the region of space that stretches from the Earth's upper atmosphere to the outermost reaches of the Earth's magnetic field. Auroras is typical phenomena in the polar regions. The origin of auroral energy is transported by solar wind, then the accumulated in the magnetosphere and finally dissipated in the ionosphere as optical aurora. This subject provides an outline of various upper atmosphere physics phenomena observed in the polar regions, from the perspective of the Sun–Earth system.	All the teaching staff in Upper Atmosphere Physics group
Polar Meteorology and Glaciology	20DPS009**	Polar climate system	2	Polar climates are unique systems, composed of a high–latitude atmosphere and oceans together with a cryosphere (snow and ice), and feature elements that play a key role in global climate. This subject presents polar climates as systems with reference to their structural elements and the interactions between them. It covers a broad range of topics, embracing the energy balance of polar atmospheres, the variation and influence of sea ice, clouds and atmospheric constituents, as well as atmosphere–cryosphere interaction and recent climate changes.	Naohiko Hirasawa
	20DPS039**	Ice–core paleoclimatology Ⅰ	2	Ice cores drilled from ice sheets and glaciers in the Arctic and Antarctica and at high mountains at low and mid latitudes provide valuable information about how the Earth's climate and environment have changed since the past. In this subject, students will obtain basic knowledge on the cyrosphere and polar ice sheets and glaciers. They will learn about the techniques for analyzing ice cores, and the past climatc and environmental changes revealed by ice core studies. They will engage in a practical exercise—studying the latest research findings by reading recently published scientific papers in English.	Kumiko Goto–Azuma
	20DPS040**	Ice–core paleoclimatology Ⅱ	2	Air extracted from polar ice cores and firn are used for reconstructing the past changes of atmospheric composition, climate and cryosphere. In this lecture, principles and methods of atmospheric and climatic reconstructions, especially by analyzing gases in ice cores and firn air, will be introduced. It also provides basics on climate and environmental changes, in particular on large global changes such as glacial–interglacial cycles and the roles of polar regions.	Kenji Kawamura
	20DPS011**	Circulation systems of water and materials in the polar atmosphere	2	This subject describes the transport and budget of moisture, atmospheric minor constituents and energy in association with the global circulation systems. It also covers observation and analysis methods and relevant basis of the atmospheric physics and chemistry. Students will work in a group to read scientific papers in turn.	Jun Inoue, Yutaka Tobo, Daisuke Goto
	20DPS013**	Cryosphere Science	2	This subject aims at understanding the role played by the cryosphere in the Earth's system. Composed mainly of ice sheets, glaciers, snowcover, frozen ground and sea ice, the cryosphere is a key factor in the climate change system. In addition to understanding the glaciological sciences, this subject deals with their relationship to global environmental change. And, students will learn methods of field observation and laboratory analysis and of data organization. Field observation exercises or practical training in a laboratory may be provided, dependent on demand. Students will work in a group to read scientific papers in turn.	Hideaki Motoyama
	20DPS044**	An exercise for experimental methods on snow and ice studies Ⅰ	2	I will teach basic experimental methods and experimental skills to study nature and properties of snow and ice in polar regions. I start from introduction of instruments and basic skills such as error handling. I will teach laboratory skills and field skills. In addition, we learn computer aided control of measurements and computer aided data acquisition. In this 1st semester, I teach basic subjects including: (i) preparations of thick sections and thin sections, (ii) density measurements, (iii) measurment on dielectric permittivity and electrical conductivity, (iv) optical properties and (v) temperature measurmennts.	Shuji Fujita

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Polar Meteorology and Glaciology	20DPS045**	An exercise for experimental methods on snow and ice studies Ⅱ	2	I will teach basic experimental methods and experimental skills to study nature and properties of snow and ice in polar regions. I start from introduction of instruments and basic skills such as error handling. I will teach laboratory skills and field skills. In addition, we learn computer aided control of measurements and computer aided data acquisition. In this 2nd semester, I teach advanced subjects including: (i) preparations of thick sections and thin sections, (ii) measurements of grain size, shape and grain boundaries, (iii) measurment on crystal orientation fabrics, (iv) air permeability, (v) measurements on dielectric permittivity tensor, and (vi) mechanical properties.	Shuji Fujita
	20DPS031**	Introduction to atmospheric science in the polar region	2	This subject aims at understanding the meteorological processes of the polar troposphere on the basis of the atmospheric physics. Lectures introduce important processes, e.g., radiation, planetary boundary layer, clouds and precipitation, and typical topics in the polar atmosphere, in order for students to have the fundamentals required for the atmospheric research in the polar regions. Short reports on given topics will be assigned in the class.	Jun Inoue
	20DPS032**	Introduction to Polar Oceanography	2	Sea ice extent in both polar oceans covers about 10% area in total earth surface. This subject gives a lecture on geophysical phenomena in the Arctic and Southern oceans and relationship to the global climate system through sea ice variations. Also, water and ice, having unique characteristics, and basic interpretation on sea ice formation/melting processes will be lectured in accompanied with recent scientific topics and future studies on polar oceanography.	Shuki Ushio
	20DPS033**	An introduction of Glaciology	2	This subject features explanation and discussion of the physical processes of snow/ice formation in polar ice sheets, including fundamental principles, with presentation of actual research data and recent research topics. The order of study will be according to the flow shown on the class plan of item 8. In addition to the listed items, cutting-edge polar environmental research topics will be discussed, as required.	Shuji Fujita
	20DPS046**	Radiation process in the polar atmosphere and cryosphere	2	The polar region has an important role in the Earth's radiation budget by behaving as a cold source due to the high snow and ice albedo. To discuss this role theoretically, the knowledge of atmospheric radiation and its application to the cryosphere is needed. In this lecture, an introduction to atmospheric radiation will be explained and followed by the radiation processes related to the atmospheric components, snow-ice physical parameters, and atmosphere-snow/ice interaction in the polar regions. In addition, you will learn snow metamorphism scheme and albedo scheme in earth system model and regional meteorological model, satellite remote sensing of snow and ice physical parameters, and in-situ observation techniques on the snow and ice surfaces.	Teruo Aoki
Polar Geoscience	20DPS015**	Crustal Evolution	2	This subject deals with the evolution of continental crust that forms the surface layer of the Earth. For this purpose, it demonstrates the basic knowledge and analytical technique to understand the crustal evolution by lecture, practical training and reading published scientiic papers. Recent examples of geochmical discussion for crustal evolution will be demonstrated.	Kenji Horie
	20DPS016**	Introduction to Marine Geophysics in the Antarctic Region	2	One of the greatest challenges in Earth sciences is understanding the mechanism of continental breakup. The seafloor of the Antarctic Ocean reveals a record of the spreading of the seafloor caused by the separation of Gondwana and of the evolution of the Antarctic plates, important clues to understanding the process of continental fragmentation. The seafloor spreading and plate tectonic evolution processes are deduced through geophysical observations such as seafloor topography, magnetic and gravity anomalies. This subject provides an outline of the features of the Antarctic plates in the context of the world's plate tectonics, through geophysical observations such as seafloor topography, magnetic and gravity anomalies. It also discusses ship-based observation equipment and data processing.	Yoshifumi Nogi

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Polar Geoscience	20DPS017**	Geodesy in polar region and application of remote sensing techniques	2	The original purpose of geodesy was to determine the shape of the Earth precisely. However, the development of satellite geodetic technologies in recent years such as GPS, satellite synthetic aperture radar (SAR) interferometry, satellite altimetry and satellite gravimetry, have not only made it possible to easily measure the shape of the Earth, but also to monitor how it changes through time. Although field observations are difficult in the polar region, remote sensing techniques are bringing to light large amounts of new information. This subject outlines the fundamentals of geodesy and explains the remote sensing techniques used in geodetic observation of the polar regions, including the results of such observations. In addition, it describes the relevance of this to global environmental change.	Koichiro Doi
	20DPS018**	Polar Seismology	2	Polar seismology covers the various kinds of phenomena in geosphere, as well as physical interaction between cryosphere, ocean and atmosphere involving global warming. This lecture deals with significant characteristics of seismic wave propagation, seismicity including glacial earthquakes, structure and dynamics of the crust and mantle, as well as the deep interior of the Earth. The observation technique in polar region, data management and international collaboration are demonstrated.	Masaki Kanao
	20DPS019**	Historical development of polar region landforms	2	(Not offerd in 2022)	
	20DPS020**	Planetary material science	2	Meteorites are of many and various types, but they can be broadly classified as primitive or differentiated, according to the process by which they are formed. Since primitive meteorites are made of matter that was never melted, they are thought to embody information about the solid materials from which the solar system was created and the processes by which their materials were formed. On the other hand, differentiated meteorites are thought to have melted from their parent celestial bodies. In addition to explaining the classification of meteorites, this subject examines the parent bodies.	Akira Yamaguchi
	20DPS021**	Evolution of terrestrial planets	2	This subject explains the basic principles of isotope systematics. It deals with experimental techniques and data analysis, and features modeling of the early evolutional processes of terrestrial planets, with reference to several analytical examples.	Keiji Misawa
	20DPS022**	Paleo– & rock Magnetism	2	This subject discusses the Earth's magnetic field, and explains the mechanism by which rocks acquire natural remnant magnetism and the magnetic characteristics of magnetic minerals. In addition, it gives some ideas about the magnetic environment of volcanic rocks, and deep sea sediments. Furthermore, it introduces techniques and measurement methods for the paleomagnetism, and also Earth dynamics, plate tectonics theory, and magnetostratigraphy.	Yusuke Suganuma
	20DPS036**	Introduction to crustal materials and processes	2	This subject offers an outline of geological phenomena in continental crusts from petrological, mineralogical and geochemical view points. In addition to understanding techniques for interpreting the traces of past changes recorded in the rocks and minerals that make up the Earth's crust, students will learn how the continental crust originated and evolved in the course of the Earth's history.	Tomokazu Hokada

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Polar Geoscience	20DPS037**	Introduction to Solid Earth Geophysics in the Antarctic Region	2	Local characteristics of the Antarctic plate reflect the history of the planet's evolution. Accordingly, to understand the evolution process of Antarctica and its current shape, it is necessary to compare and understand its local characteristics, such as crust and mantle structure, geoid, gravity anomalies and crustal magnetic anomalies, with those of the other areas. This subject describes features of Antarctica, as determined by a seismic velocity survey and/or regional tomography, crustal magnetic survey, and free-air and Bouguer gravity surveys. In addition, details about defromations of the solid Earth induced by the tidal potential, surface loadings and Earth's rotation are also presented.	Yoshifumi Nogi, Koichiro Doi
	20DPS038**	An introduction to Quaternary in the polar regions	2	The approximately 2.6 million years of the Quaternary period, the latest period in the Earth's historical evolution, has featured large-scale growth and decay in ice sheet conditions, marked variations in sea levels and dramatic change in the Earth's crust. These factors have enabled nature to take shape as we see it today and for humanity to evolve as it has. As a principal stage for these changes, the polar regions represent a key to understanding how they occurred. This subject begins by explaining the techniques and concepts used to elucidate and recognize the various changes in the evolution of nature during the Quaternary period. Next, the latest research trends are used to discuss the role of Quaternary research in understanding the system of the Earth, to assess the possibility of predicting forthcoming changes in the natural environment and human development, and to reflect on the position of humanity in the context of the Earth's history.	Junichi Okuno
Polar Biosphere Science	20DPS023**	Animal Behaviour and Ecology in Polar Regions	2	This course aims to present an introduction to studies on behaviour and ecology of marine animals in polar region. Students are introduced to the basics of behavioural ecology, and to the ways of adaptations shown by marine animals to the dynamic polar environment. Then, various topics in recent behavioural and ecological studies of marine top predators in polar region will be explored via reading sessions of journal articles.	Akinori Takahashi, Nobuo Kokubun
	20DPS041**	Behavioural Analysis of Marine Animals	2	This subject outlines the fundamentals of behavioural data analysis for marine animals. It overviews the behavioural measurement of marine animals, especially the biologging techniques, and basics of behavioural data analyses. Students also pursue practical exercises of using biologging techniques and analyzing the body acceleration and movement trajectories of marine animals.	Yuuki Watanabe
	20DPS024**	Physiological Ecology of polar photosynthetic organisms	2	This subject outlines the characteristics of polar environments in terms of biological adaptation to the environment, particularly physiological adaptation of aquatic microorganisms and flora. In addition, it provides practical training in the measurement of photosynthesis and other physiological activities and in techniques for outdoor research.	Sakae Kudoh
	20DPS025**	Primary production in polar oceans	2	In marine ecosystem primary production is principally the production process of organic matter due to photosynthesis, which is understood to be the starting point of the complex food chains and food webs of the sea. While solar radiation is indispensable for photosynthesis, available sunlight is far more seasonal in the polar oceans than in middle-latitude regions. Whilst summer offers 24 hours of solar radiation and features a midnight sun, winter is the exact opposite. This subject examines the process of primary production in the polar seas in light of these exceptional solar environmental conditions.	Toru Hirawake
	20DPS026**	Data Analysis for Ocean Remote Sensing	2	This subject explains from fundamentals of satellite remote sensing to their applications, covering the technical aspects of onboard satellite sensors and sensor operation methods. Also outlined are how to acquire ocean remote sensing data collected by earth observing satellites for studying polar ocean sciences and how to process them with computer application packages through lectures and training. It will introduce application examples in marine biological researches in polar areas.	Toru Hirawake

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Polar Biosphere Science	20DPS027**	Biodiversity in polar regions	2	This subject explains the various methods of plant and animal reproduction, food chains, the structure and function of plant and animal communities, distribution patterns and ecosystems in the polar regions, and it discusses the differences between the two polar (Antarctic and Arctic) regions and the extreme environments of high mountains, volcano mouths and the deep sea. In view of the considerable energy invested in searching for microorganisms in extreme environments in recent years, the role played by microorganisms in the ecosystems of polar regions is also studied.	Satoshi Imura
	20DPS028**	Polar Limnology and Ecology	2	This subject explores the characteristics of lake environments in polar regions, particularly those along the Antarctic coast, from an ecological perspective. It explains the fundamentals of limnology and the ecological discoveries made through limnology. Also covered are field observation and experiment methods used to study the lake ecosystems around the Showa Station where NIPR began observations in recent years.	Sakae Kudoh
	20DPS029**	Analysis of terrestrial ecosystem in polar regions	2	The objective of this subject is to deepen understanding of the various approaches to research and observation and the methods used to study polar terrestrial ecosystems. Students will be exposed to actual observation activities in polar regions, based on experience in the field.	Masaki Uchida
	20DPS034**	Biological oceanography in polar seas	2	Our knowledge on the polar marine environments is essential for understanding the global environmental issues. The unique marine ecosystems of polar regions are closely associated with sea ice formation, and the marine biological production processes centered on these ecosystems strongly influence marine environments. This subject aims to develop a deeper understanding of how this structure relates to the dynamics of marine organisms. In particular, the role of zooplankotn in the polar marine ecosystem is outlined. Field work on sea ice will be carried out.	Kunio Takahashi
	20DPS035**	Introduction to Terrestrial Ecology in Polar Region	2	This subject aims for a deeper fundamental understanding of polar terrestrial ecosystems, which are composed of forms of life that can withstand environments of extremely low temperature and dryness. Focusing mainly on vegetation such as moss, lichens and algae, on animals such as mites, springtails and tardigrades, and on bacteria, the reproductive structure, interspecific relationships and transformation of these life forms in simple ecosystems will be discussed, with emphasis on environmental problems.	Satoshi Imura
Common	90DPS001**	Special Lectures for Dissertation Ⅰ	2	Adviser provides research guidance to help in creating a degree thesis.	Mentor
	90DPS002**	Special Lectures for Dissertation Ⅱ	2	Adviser provides research guidance to help in creating a degree thesis.	Mentor
	90DPS003**	Special Lectures for Dissertation Ⅲ	2	Adviser provides research guidance to help in creating a degree thesis.	Mentor
	90DPS004**	Special Lectures for Dissertation Ⅳ	2	Adviser provides research guidance to help in creating a degree thesis.	Mentor
	90DPS005**	Special Lectures for Dissertation Ⅴ	2	Adviser provides research guidance to help in creating a degree thesis.	Mentor
	90DPS006**	Special Exercise for Dissertation Ⅰ	2	Seminar-style practical exercises are conducted for each of the fields of polar science in which research guidance is provided.	Mentor
	90DPS007**	Special Exercise for Dissertation Ⅱ	2	Seminar-style practical exercises are conducted for each of the fields of polar science in which research guidance is provided.	Mentor
	90DPS008**	Special Exercise for Dissertation Ⅲ	2	Seminar-style practical exercises are conducted for each of the fields of polar science in which research guidance is provided.	Mentor
	90DPS009**	Special Exercise for Dissertation Ⅳ	2	Seminar-style practical exercises are conducted for each of the fields of polar science in which research guidance is provided.	Mentor
	90DPS010**	Special Exercise for Dissertation Ⅴ	2	Seminar-style practical exercises are conducted for each of the fields of polar science in which research guidance is provided.	Mentor

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