

Common Specialized Subjects of the School of High Energy Accelerator Science

Course Code	Subject	Credit	Content of subject	Instructor
10SHA001**	High Energy Accelerator Seminar I	2	Active fields of accelerator related science, such as elementary particles, nuclear physics, materials science and life science etc., will be presented by front-line researchers.	
10SHA002**	High Energy Accelerator Seminar II	2	Active fields of accelerator related science, such as elementary particles, nuclear physics, materials science and life science etc., will be presented by front-line researchers.	
10SHA003**	High Energy Accelerator Seminar III	1	Active fields of accelerator related science, such as elementary particles, nuclear physics, materials science and life science etc., will be presented by front-line researchers.	
10SHA004**	High Energy Accelerator Seminar IV	1	Active fields of accelerator related science, such as elementary particles, nuclear physics, materials science and life science etc., will be presented by front-line researchers.	
10SHA007**	High Energy Accelerator Seminar VII	2	Active fields of accelerator related science, such as elementary particles, nuclear physics, materials science and life science etc., will be presented by front-line researchers.	
10SHA008**	High Energy Accelerator Seminar VIII	2	Active fields of accelerator related science, such as elementary particles, nuclear physics, materials science and life science etc., will be presented by front-line researchers.	
10SHA009**	Introduction to Accelerators I	2	General introduction to accelerators in omnibus-style classes for specific fields by the experts and given in Japanese.	
10SHA010**	Introduction to Accelerators II	2	General introduction to accelerators in omnibus-style classes for specific fields by the experts and given in English.	
10SHA027**	Seminar on Introduction to Accelerators I	2	General introduction to accelerators in omnibus-style seminars and practicals for specific fields by the experts and given in Japanese.	
10SHA028**	Seminar on Introduction to Accelerators II	2	General introduction to accelerators in omnibus-style seminars and practicals for specific fields by the experts and given in English.	
10SHA011**	Introduction to Experimental Methods Using Accelerators	2	Introductory lectures on basic phenomena and methods necessary in experiments of particle, nuclear, synchrotron light using accelerators. They will involve special relativity, scattering, cross section, bremsstrahlung, synchrotron radiation, vacuum, electric discharge, diffraction, etc.	YOSHIDA, Mitsuhiro
10SHA012**	Radiation Physics	2	This class is on the basic topics about generation of radiation ray and interaction of radiation and matter. 1. Structure of atom and ionization 2. Structure of nucleus 3. Decay of radioactive nucleus 4. Nuclear interaction 5. Interaction of x ray and gamma ray 6. Interaction of beta ray 7. Interaction of proton ray and alpha ray 8. Interaction of neutron 9. Transfer of energy to material 10. Quantity and unit of radiation ray.	YAMAZAKI, Hirohito SAITO, Kiwamu
10SHA013**	Beam Physics I	2	Principles of accelerators, generation of synchrotron light, collective motion of beams, and coherent synchrotron radiation etc. are presented from the unified viewpoint of beam physics. Single particle dynamics is treated mainly by course I, and collective motion and coherent effects are treated mainly by course II.	NAKAMURA, Norio
10SHA014**	Beam Physics II	2		
10SHA015**	Applied Mathematics	2	Main theme of the course is the complex analysis of one variable. In addition, related other branches will be also lectured. Through the course, mathematical image (intuition) and technique of students will be refined and advanced.	MORITA, Akio NISHIKAWA, Patrice

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10SHA016**	Electromagnetism	2	Lectures on basics of electromagnetism necessary to understand accelerators will be given. Contents: Vector Analysis /Static electromagnetic field /Maxwell equations /Transmission of electromagnetic field /Waveguides and resonant cavities/Radiation from charged particles /Interaction between charged particles and material (electromagnetic field).	ABE, Tetsuo
10SHA017**	Electrodynamics and Special Relativity	2	This course will cover the special theory of relativity and the theory on relativistic motion of particles which is a basis of particle motion in accelerators.	
10SHA018**	Analytical Dynamics	2	This course introduces practical techniques for the simulation and understanding of dynamical systems with special emphasis on accelerators.	NISHIKAWA, Patrice
10SHA019**	Quantum Mechanics	2	Introduced will be important concepts to understand elementary quantum mechanics, such as the Bohr model of atom/ the Sommerfeld-Wilson quantization condition/ Schrödinger equation/ commutation relation of operators and uncertainty principle/ state transition probability/ path integral and classical limit. Similarity and difference to classical mechanics will be highlighted.	MORITA, Akio NISHIKAWA, Patrice
10SHA020**	Thermodynamics/Statistical Mechanics	2	The lecture starts from the explanation of basic materials such as the entropy, thermodynamic laws, partition function, etc. As an application, selected topics related to accelerator, such as surface phenomena, refrigerator, etc will be discussed.	NAKANISHI, Kota
10SHA021**	Modern physical chemistry	2	Fundamental concepts of physical chemistry will be presented. Also, basic experimental methodologies for understanding non-equilibrium system, catalysis and surface chemistry will be discussed.	
10SHA022**	Introduction to the Condensed Matter Physics	2	Fundamental concepts for the understanding of condensed matter are presented with an introduction to the microscopic probes including synchrotron radiation, neutron and muon as tools for the study of electronic property.	KODA, Akihiro
10SHA023**	Introduction to Biology	2	Basic concepts of modern biology including biochemistry, molecular biology and cell biology with particular attention to structural biology.	SENDA, Toshiya
10SHA025**	Modern Quantum Mechanics	2	This course covers the fundamentals of quantum information and its recent development. In particular, EPR pairs and observation problems, quantum entanglement, quantum gates, quantum computation, quantum cryptography, quantum annealing, etc. will be studied.	HIDAKA, Yoshimasa
10SHA026**	Measurement and control technology for experimental physics	2	The basics and applications of measurement and control technologies in physics experiments are presented by researchers in both schools of accelerator and physical sciences. The course makes clear the similarity and difference of experimental technologies in both science field, and introduces ideas for interdisciplinary collaboration.	KISHISHITA, Tetsuichi
90SHA001**	Qualifying Research in High Energy Accelerator Science	4	Students are required to perform a research on an advanced subject in accelerator science.	adviser
10SHA029**	Basis and application of synchrotron radiation	1	This course provides an overview of basis and application of synchrotron radiation, such as synchrotron light source, beamline technology, X-ray absorption spectroscopy (XAS), X-ray absorption fine structure (XAFS), magnetic circular dichroism (MCD), X-ray photoelectron spectroscopy (XPS), angle-resolved photoemission spectroscopy (ARPES), X-ray imaging, and scanning transmission X-ray microscope/microscopy (STXM).	HIRANO, Keiichi MASE, Kazuhiko ABE, Hitoshi KITAMURA, Miho
10SHA030**	Particle accelerator and detector	1	The lecture gives an introductory course of particle accelerators and detectors which will be essential in various field of fundamental science like experimental particle and nuclear physics, photon science or neutron science using quantum beam.	HABA, Junji

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10SHA031**	Soft Condensed Matter Physics	2	Properties of soft condensed matters such as polymers, liquid crystals, colloids, and amphiphilic molecules will be explained from the viewpoint of physics.	SETO, Hideki
10SHA032**	Introduction to Symmetry and Space group	2	The training course aims at providing a solid background in symmetry and group theory using various materials structures. Participants are requested to actively take part in solving the proposed exercises.	NESPOLO, Massimo
10SHA033**	Basic of signal processing for sensors	1	A lab-intensive introduction to basics of sensors and their analog signal processing design skills through design exercises, discussion using Computer Aided Design(CAD) tools for detection system development(e.g. imaging sensor system etc)	MIYAHARA, Masaya
10SHA034**	Introduction to Data Science	1	This course introduces the statistical processing for Big Data, Multivariate analysis, Machine Learning, in particular, the principles of Deep Learning and its application with exercise.	NAKAMURA, Tomoaki YONAMINE, Ryo KISHIMOTO, Tomoe
10SHA035**	Control of distributed devices for large systems	1	EPICS (Experimental Physics and Industrial Control System) is a toolkit to monitor and control many devices, which are distributed over a wide area. At the beginning, EPICS was developed and used in an accelerator community. For example, KEK introduced EPICS into SuperKEKB and J-PARC accelerators. In addition, EPICS has been introduced in non-accelerator fields: telescopes, laser interferometers for gravitational-wave detections, and nuclear fusion facilities. Nowadays developments and maintenances of EPICS have been continued under a world-wide collaboration. In the class, introduction of EPICS will be given, followed by hands-on lessons with a tiny computer (Raspberry Pi). Students, who are expected to have knowledge of basic Linux commands, will study basic functions of EPICS by implementing EPICS and controlling remote I/O signals.	KAMIKUBOTA, Norihiko
10SHA036**	Practicum for accelerator science using the education-oriented electron linear accelerator	1	In this lecture, a practice and an exercise are performed based on the small-scale linear electron accelerator (linac) which is under constructing as the educational oriented accelerator. Students attending lectures are not demanded to have any knowledges for accelerator, therefore, introductory lecture is performed first, then basic course of an electron gun, a radio-frequency (rf) accelerator and an rf source. Simulation practices are aimed to obtain the designing basic devices of the accelerator. Exercises using the linac are also planned. Lecture of the 1st term will be done using Japanese, and the 2nd term using English. Remote assessing for the lecture is also available.	FUKUDA, Masafumi FUKUDA, Shigeki
10SHA037**	Advanced digital circuit design and development for measurement and control systems	1	The objective of this lecture is to learn the structure of Xilinx FPGA (Field Programmable Gate Array), which is widely used for readout electronics in experiments using accelerators, and the characteristics of the dedicated functional blocks, and to reach the level of knowledge required in actual development. In this lecture, students will learn about the structure of FPGAs, arithmetic operations, IOSERDES, memory resources, and high-speed serial transceivers through classroom and exercises. Students are expected to have already completed Measurement and control technology for experimental physics and Basic digital circuit design and development for measurement and control systems, or have equivalent knowledge. This lecture is designed for those who have been involved in FPGA circuit development for more than one year.	HONDA, Ryotaro

: Compulsory Subject

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