

College of Physics

■ Bachelor of Science

Program Educational Objectives

We aim to cultivate internationally minded graduates who, through the creation of new knowledge grounded in physics and its sound implementation in society, will contribute to the exploration of the fundamental sciences represented by particle and nuclear physics, astrophysics, condensed-matter physics, and life sciences, and to solving critical challenges in the cutting-edge fields of contemporary society, including decarbonization and energy transition, quantum and information technologies, advanced materials, healthcare, the global environment, and the reliability and ethics of science and technology. They will help build a society in which the pursuit of knowledge is embedded as culture and intellectual curiosity is fulfilled, as well as a sustainable, safe, and just society.

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| Graduate Profile | <p>We aim to cultivate individuals who possess research capability grounded in a solid foundation in mathematics and physics—from fundamentals to applications—and in advanced specialized knowledge; who demonstrate logical reasoning honed through the pursuit of physical truth; who can independently formulate problems and solve them in an integrated manner; and who couple broad intellectual cultivation with sound ethics, moral awareness, and a strong sense of social responsibility.</p> <p>Such graduates will create new knowledge across diverse fundamental sciences and the cutting-edge fields of contemporary society; lead the social implementation, standardization, and intellectual-property development of research outcomes through industry–academia–government partnerships and international collaboration; contribute to science communication and science education; and help drive the formation of a sustainable, safe, and just society.</p> |
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| <p>Career Paths after Graduation / Completion</p> | <p>The abilities cultivated through the study of physics—to express phenomena in equations, build models, and reason logically in a structured manner, and to identify problems independently and lead them to solutions—are valuable across disciplines. Graduates are expected to thrive in diverse fields such as research, industry, policy, and education.</p> <ul style="list-style-type: none"> - University Faculty & Research Careers: Engage in cutting-edge research at universities, research institutes, and corporate R&D. - Quantum, Semiconductors & Electronic Devices: Quantum metrology/algorithms, process development, reliability engineering. - Energy & Decarbonization: Renewable energy, batteries, hydrogen; LCA/ESG. - Advanced Materials & Measurement: Materials design/materials informatics, physical-property characterization, quality assurance, intellectual property. - Healthcare & Med-Engineering: Medical imaging, radiation physics, diagnostic devices, data analysis. - Space, Disaster Resilience & Earth Sciences: Satellite observation, weather/earthquake modeling, data assimilation. - Data Science & AI: Data analytics, machine learning, numerical computation, algorithm development. - Finance, Consulting & Policy: Quantitative finance, R&D strategy, science-and-technology policy. - Public Administration, Regulation & Standardization: National metrology standards, safety and quality, international standardization. - Education & Science Communication: Secondary-school teacher, museum curator, science writer. - Entrepreneurship & Venture Creation: Deep-tech startups, university spin-offs. |
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Diploma Policy

We grant diplomas for Bachelor of Science to persons who have acquired the knowledge and skills (Generic Competences) to accomplish the educational purpose for undergraduate students of University of Tsukuba, and have achieved the following knowledge and skills (Specialized Competences) based on the educational purpose of our school and college.

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| Knowledge and Skills (Specialized Competences) | 1. Understanding of natural sciences | Understanding concepts and ways of thinking that are bases for natural science, and abilities to solve problems |
| | 2. Understanding of classical physics | Understanding concepts and ways of thinking that are bases for classical physics, and abilities to solve problems |
| | 3. Understanding of modern physics | Understanding concepts and ways of thinking that are bases for modern physics, and abilities to solve problems |
| | 4. Understanding of specialized physics | Understanding concepts and ideas of specialized physics in each field, and abilities to solve problems |
| | 5. Computational analysis skills | Abilities to implement computer programs and to obtain proper physical insights from numerical results |
| | 6. Ability to analyze experiments | Understanding principles and operation of experiments, and abilities to properly obtain physical meaning from the results |
| | 7. Professional dialogue skills | Ability to express and discuss physics content in English |
| | 8. Problem solving skills | Ability to explore and solve problems in physics independently |
| Guidelines for Assessing Learning Outcomes | <p>The knowledge and skills (competences) set forth in the “Diploma Policy” are assessed from two perspectives: learning outcomes in individual courses and the culminating outcomes demonstrated in the bachelor's thesis.</p> <ul style="list-style-type: none"> – Course-based assessment: In each course, competence attainment is evaluated using exams, short tests, reports, and other instruments appropriately combined in accordance with the direct assessment criteria for competences specified in the syllabus. – Capstone (bachelor's thesis) assessment: Positioning the bachelor's thesis as the culmination of learning, multiple faculty members from the relevant field and from other fields conduct a comprehensive evaluation of competence achievement through the thesis presentation session, including the oral presentation and Q&A. | |

Curriculum Policy

We organize and implement curricula based on the following policies for programs that allow students to acquire learning outcomes related to Bachelor of Science.

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| <p>Curriculum Design Framework</p> | <p>General policy We organize a systematic curriculum that enables students to acquire competences stepwise and effectively, progressing from the fundamentals of the natural sciences to highly specialized modern physics. Our instructional methods appropriately combine lectures, exercises, and experiments, and incorporate inquiry-based learning, online (on-demand) classes, and small-group instruction to foster active, interactive, and deep learning. In addition, we make assessment criteria explicit and visualize learning outcomes, and we continuously improve instructional methods and content based on student feedback.</p> <p>Course sequence policy Physics has advanced through a repeated process of building upon the achievements of predecessors and accumulating newly discovered knowledge. Even in modern physics—which is highly developed and specialized across diverse fields—fundamental concepts are used universally. Over the four years of the College, we set a standard year of learning for each course and state intended learning outcomes in the syllabus so that students can progress in sequence: from classical physics as a foundation, to basic courses forming a core of the modern physics, and then to highly specialized developing courses.</p> <ul style="list-style-type: none"> – The first year: Students acquire essential mathematical foundations such as linear algebra and calculus, while learning the core of classical physics—mechanics and electromagnetism—viewed from the perspectives of point mass and fields. They also study a broad range of the natural sciences (chemistry, biology, and earth science) to develop wide-ranging knowledge and general education. – The second year: Through courses such as analytical mechanics, thermal physics, and advanced electromagnetism, students deepen their understanding of classical physics and, at the same time, master the fundamentals of modern physics, including quantum mechanics and relativity. They also learn basic methods in physics experiments. – The third year: Students study more advanced topics in modern physics through courses such as quantum mechanics and statistical mechanics, and build foundations in the specialized physics of each field—particle, nuclear, plasma, condensed matter, and astrophysics. Experiments in each area further strengthen their understanding of how theory and experiment function as the two wheels of physics. – The fourth year: Each student joins a laboratory to study specialized physics and conduct graduation research. <p>Implementation policy Each course is typically aligned with multiple competences. The competence values earned upon successful completion are quantified such that the sum of the competence values assigned to that course equals the number of credits for the course. This enables students to track the competences they have acquired quantitatively and cumulatively, and to verify their level of attainment systematically with reference to the Degree Awarding Policy.</p> |
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Teaching and Learning Methods

Grounded in lectures, exercises, and experiments, our program enables students to acquire physics stepwise and systematically from the fundamentals to advanced specialties, while emphasizing active, interactive learning.

- “Introduction to Physics” (the first year)

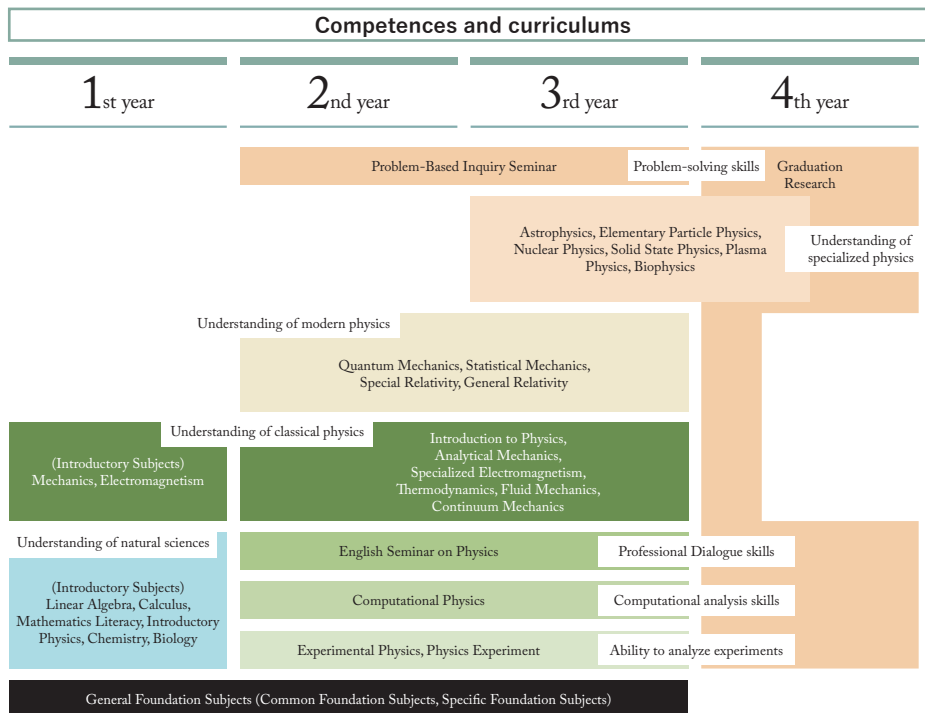
We offer an introductory specialty course that situates modern physics in an overarching perspective and provides a roadmap for subsequent study, clarifying early on what and why students will learn in later years.
- Problem-Based Inquiry Seminar (the second and third years)

Throughout the year, students engage in small-group tutorial learning on diverse topics aligned with their interests. With close faculty guidance, they conduct literature reading, experiments, numerical computation, and presentations, thereby developing problem-formulation and inquiry skills.
- Integrated Lectures and Exercises

In major courses, lectures and exercises are designed as a single sequence, with careful explanations, ample practice time, and immediate feedback to consolidate understanding and strengthen application skills.
- Specialized English and the Fostering of International Competence

By combining e-learning with classes taught by international faculty, students cultivate communication skills that are effective globally, including research presentations and the reading, writing, and discussion of technical documents.
- Foundational Rigor in Experiment Courses

From the basics upward, we provide systematic instruction in report writing, data processing, uncertainty evaluation, and figure/table preparation, enabling students to acquire scientific writing skills and reproducible experimental techniques.

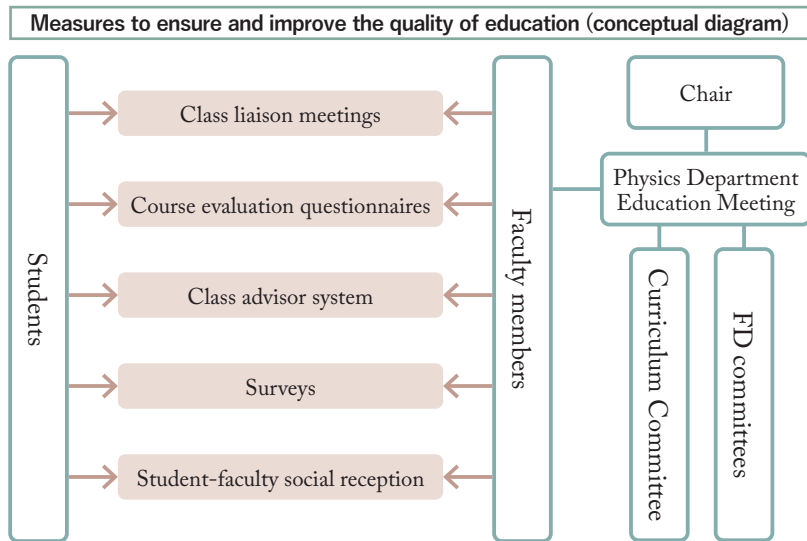


Admission Policy

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| Desired Student Profile | We seek candidates who possess the basic academic abilities in various high school subjects and the ability to further study physics in the university. Students are expected to have a wide perspective of view, learn by themselves, and flexibly deal with unknown matters. | |
| Student Evaluation and Selection | Individual Achievement Test First Round | We conduct a comprehensive evaluation of overall basic academic ability and of the logical reasoning, thinking, and application skills required to study physics. |
| | Individual Achievement Test Second Round | In addition to assessing overall basic academic ability, we comprehensively evaluate the logical reasoning, thinking, and application skills required for studying physics, as well as a broad interest in physics and strong motivation to learn. |
| | Entrance Examination by School Recommendation | Beyond an excellent academic record in high school, we comprehensively evaluate a high level of interest in physics, clear academic purpose, and willingness to engage proactively in learning. |
| | Entrance Examination for IB Students | We comprehensively evaluate strong curiosity about the natural sciences and a broad international outlook, together with the basic academic abilities related to physics and motivation to pursue studies in physics. |
| | Entrance Examination for Foreign School Students | Type 1/2) We comprehensively evaluate a high level of interest in physics, the language proficiency necessary to study physics after enrollment, and the requisite basic academic abilities. |
| | Transfer examination | We comprehensively evaluate basic academic abilities at approximately the second-year university level, along with the logical reasoning, thinking, and application skills necessary to study and master physics. |

Learning Support Framework

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| Academic Support | Advising meetings and course - registration guidance by class advisors; provision of instructional materials on foundational coursework (e.g., mathematical methods for physics); Guidance in laboratory report writing; Presentation coaching for Physics Experiments II and graduation research. |
| Opportunities for Peer Interaction | Student interaction through activities such as the First-Year Seminar and class representatives' meetings; group-based learning in physics laboratory courses; and student–faculty social gatherings (the “Newton Festival”). |
| Opportunities for Student–Faculty Interaction | Exchange of views on course content and the learning environment at class liaison meetings; student–faculty social gatherings (the “Newton Festival”); small-group instruction in the Problem-Based Inquiry Seminar; scheduled office hours for each course; and advising meetings with class advisors. |



Approaches to Assuring and Enhancing Educational Quality

- Standing Curriculum Committee — A Curriculum Committee of approximately ten faculty members meets monthly to conduct ongoing review and improvement of all educational activities. In addition, by undertaking reviews based on the results of learning-outcomes assessment, the Committee assures educational quality and strengthens the framework for achieving the objectives of the degree program.
- Faculty development for major course groups — Several meetings are held annually for each course group (“Mechanics,” “Electromagnetism,” “Quantum Mechanics,” “Statistical Mechanics,” and “Physics Experiments”) to report on teaching and discuss areas for improvement.
- Rigorous grading — Course performance is strictly evaluated using published grading methods, based on an appropriate combination of exams, short tests, reports, and other instruments specified in the course plan.
- Course evaluations and class liaison meetings — Student-designed surveys are administered for all foundational and specialized courses, and the results are published. Class liaison meetings are held twice a year to pursue course improvements based on the survey findings.
- Alumni surveys — Surveys are conducted immediately after graduation and again five and ten years later, and the results are used to improve the curriculum and related practices.
- Current-student surveys — As appropriate, surveys on various topics are conducted and used to enhance the curriculum and other aspects of the program.