Department of Physics

Program of Applied Physics for International Students (2024)

I. Introduction

Applied physics is a discipline which aims at the applications of the laws of physics for developing new technologies, new functional materials, and solving some particular engineering problems. In the past century, breakthroughs in theoretical physics have triggered revolutions in modern industries, such as nuclear energy, semiconductor, superconductor, laser, aviation and aerospace, etc. At present, physics plays a great role in economy and our daily life. While in the future, progresses in areas like fusion energy, new energy materials, high temperature superconductivity, metamaterials and quantum information are expected. It is then a big challenge to transfer the latest achievements in physics to technologies and practical applications.

Southern University of Science and Technology is located in Shenzhen city which is one of the most developed areas in China. There are numbers of high-tech enterprises in the city which bring pressing needs for original innovation of technology and high-level R&D technicians and engineers. Applied physics serves as a bridge between physics and other majors like chemistry, materials science and engineering, electrical and electronic engineering, etc., in SUSTech, providing a training program of the above needs, and a platform for developing new technologies.

Academic subject areas: Physics

Program code: 070202

II. Objectives and Learning Outcomes

1. Objectives

The major provides systematic applied physics training for students who can engage in research, teaching, technology development and management in Applied Physics and related science and technology fields (such as materials science, semiconductor industry, electronic information, computer industry, etc.), or who can further study in related disciplines.

2. Learning Outcomes

The students should meet the requirements of the Ministry of Education on the ideological and political theory and moral education of undergraduates. Besides certain humanistic literacy, aesthetic literacy and social science knowledge, and establish correct labor values and attitudes, the students should acquire the following professional skills.

1. Good Mathematical Foundation
2. Mastering the Basic Theory and Principles of Physics
3. Master the methods and skills of physics experiment
4. Understanding Industrial Production Activities
5. Professional knowledge in science and Engineering
6. Ability of computer programming, application and numerical calculation
7. Good English reading, writing and communication skills
8. Good oral expression, communication and coordination skills and teamwork spirit
9. Have a certain ability to acquire knowledge independently
10. Ability of scientific spirit, innovative consciousness, theoretical application and Technological Development

III. Study Length, Degree, and Graduation Requirements

1. Study length: 4 years.

2. Degree conferred: Students who complete and meet the degree requirements of the undergraduate program will be awarded a bachelor's degree in Science

3. The minimum credit requirement for graduation: 155 credits. The specific requirements are as follows.

Module		**Category**	**Minimum Credit Requirement**
General Education Courses	Chinese Language and Culture Module	Chinese Language and Culture	16
	Arts and Physical Education Module	Physical Education	4
		Arts	2
	Competence Development Module	Computer Programming	3
		Writing	2
		Foreign Languages	14
	Humanities and Social Sciences Module	Humanities	6
		Social Sciences	
		Chinese Studies	2
	Mathematics and Natural Sciences Module	Mathematics	12
		Physics	10
		Chemistry	3
		Geoscience + Life science	3
	GE to Majors Bridging Module	Introduction to Majors	2
Major Courses	Major Required Courses	Major Foundational Courses	26
		Major Core Courses	20
		Practice-based Learning (Undergraduate Thesis, Internships, Research projects, etc.)	16
	Major Elective Courses	Major Elective Courses	14
Total			155
Note: please see the General Education Requirement for more details on Chinese Language and Culture Module, Arts and Physical Education Module, Competence Development Module（Foreign Languages & Writing）, Humanities and Social Sciences Module, and GE to Majors Bridging Module.			

IV. Course Requirements for the Mathematics and Natural Sciences Module and Computer Programming

Course Category	Course Code	Course Name	Credits	Terms	Prerequisite	Dept.
Mathematics	MA117	Calculus I	4	1 Fall	None	Department of Mathematics
	MA127	Calculus II	4	1 Spring	Calculus I	
	MA113	Linear Algebra	4	1 Spring & Fall	None	
Physics	PHY105	College Physics I	4	1 Fall	None	Department of Physics
	PHY106	College Physics II	4	1 Spring	College Physics I	
	PHY104B	Experiments of Fundamental Physics	2	1 Spring & Fall	None	
Chemistry	CH105	Chemistry: The Central Science	3	1-2 Spring & Fall	None	Department of Chemistry
Geoscience + Life science (Choose one from two)	BIO102B	Introduction to Life Science	3	1-2 Spring & Fall	None	Department of Biology
	EOE100	Introduction to Earth Sciences	3	1-2 Spring & Fall	None	Dept. of Earth and Space Sciences, Dept. of Ocean Science and Engineering, School of Environment
Computer Programming (Choose one from five)	CS109	Introduction to Computer Programming	3	1-2 Spring & Fall	None	Dept. of Computer Science and Engineering
	CS110	Introduction to Java Programming	3	1-2 Spring & Fall	None	
	CS111	Introduction to C programming	3	1-2 Spring & Fall	None	
	CS112	Introduction to Python Programming Python	3	1-2 Spring & Fall	None	
	CS113	Introduction to Matlab Programming	3	1-2 Spring & Fall	None	

Note:

1. Mathematics: MA101a Mathematical Analysis I, MA102a Mathematical Analysis II can replace MA117 Calculus I, MA127 Calculus II;
2. Algebra: MA107 Advanced Linear Algebra I can replace MA113 Linear Algebra;
3. Physics: PHY101 General Physics I , PHY102 General Physics II can replace PHY105 College Physics I, PHY106 College Physics II;
4. Chemistry: CH103 General Chemistry can replace CH105 Chemistry: The Central Science;
5. Geoscience + Life science: BIO103 Principles of Biology can replace BIO102B Introduction to Life Sciences.
6. The above alternative courses are also applicable to "Prerequisites for Major Declaration".

V. Prerequisites for Major Declaration

<table>
<tr><th>Major Declaration Time</th><th colspan="2">Course Code</th><th>Course Name</th><th>Prerequisite</th></tr>
<tr><td rowspan="6">Declare major at the end of the first academic year</td><td colspan="2">PHY105</td><td>College Physics I</td><td>None</td></tr>
<tr><td colspan="2">PHY106</td><td>College Physics II</td><td>College Physics I</td></tr>
<tr><td colspan="2">PHY104B</td><td>Experiments of Fundamental Physics</td><td>None</td></tr>
<tr><td colspan="2">MA117</td><td>Calculus I</td><td>None</td></tr>
<tr><td colspan="2">MA127</td><td>Calculus II</td><td>Calculus I</td></tr>
<tr><td colspan="2">MA113</td><td>Linear Algebra</td><td>None</td></tr>
<tr><td rowspan="10">Declare major at the end of the second academic year</td><td colspan="2">PHY105</td><td>College Physics I</td><td>None</td></tr>
<tr><td colspan="2">PHY106</td><td>College Physics II</td><td>College Physics I</td></tr>
<tr><td colspan="2">PHY104B</td><td>Experiments of Fundamental Physics</td><td>None</td></tr>
<tr><td colspan="2">MA117</td><td>Calculus I</td><td>None</td></tr>
<tr><td colspan="2">MA127</td><td>Calculus II</td><td>Calculus I</td></tr>
<tr><td colspan="2">MA113</td><td>Linear Algebra</td><td>None</td></tr>
<tr><td rowspan="5">Computer Programming (Choose one from five)</td><td>CS109</td><td>Introduction to Computer Programming</td><td>None</td></tr>
<tr><td>CS110</td><td>Introduction to Java Programming</td><td>None</td></tr>
<tr><td>CS111</td><td>Introduction to C programming</td><td>None</td></tr>
<tr><td>CS112</td><td>Introduction to Python Programming Python</td><td>None</td></tr>
<tr><td>CS113</td><td>Introduction to Matlab Programming</td><td>None</td></tr>
<tr><td colspan="5">Note:
1. If the number of students entering a major at the end of the first academic year in the department is greater than or equal to the total number of the teaching-research faculty (PI)*2*60%, all majors in the department may implement the prerequisites for major declaration at the end of the second academic year.
2. If the number of students entering a major at the end of the first academic year in the department is less than the total number of the teaching-research faculty (PI)*2*60%, all majors in the department do not implement the prerequisites for major declaration at the end of the second academic year.
3. Suppose the number of students applying for a major at the end of the first academic year exceeds four times the total number of the teaching-research faculty (PI), then the department may select students according to predetermined rules. In principle, the rules set by the department shall examine the students' suitability for the major and not based on weighted GPA (Specific rules shall be set by the department and announced in advance).
4. For departments that do not implement prerequisites for major declaration at end of the second academic year, if the cumulative number of students applying for a major at the end of the second academic year and the number of students who have entered a major at the end of the first academic year exceeds four times the total number of the teaching-research faculty (PI), the department may select students according to predetermined rules. In principle, the rules set by the department shall examine the students' suitability for the major and not based on weighted GPA (Specific rules shall be set by the department and announced in advance).</td></tr>
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VI: Major Course Arrangement

Table 1: Major Required Courses

Program of Applied Physics

Course Category	Course Code	Course Name	Credits	Practice-based Learning Credits	Terms	Prerequisite	Dept.
Major Foundational Courses	ME102	CAD and Engineering Drawing	3	1.5	1/Spr	None	ME
	PHY201-15	Physics Laboratory II	2	2	2/Fall	PHY105, PHY104B	PHY
	PHY203-15	Mathematical Methods in Physics	4		2/Fall	MA127, PHY106, MA113	PHY
	PHY205-15	Analytical Mechanics	3		2/Fall	PHY106	PHY
	PHY207-15	Electrodynamics I	3		2/Fall	PHY203-15	PHY
	PHY202	Physics Laboratory III	2	2	2/Spr	PHY105, PHY104B	PHY
	PHY204	Thermodynamics and Statistical Physics I	3		2/Spr	PHY106	PHY
	PHY206-15	Introduction to Quantum Mechanics	3		2/Spr	PHY203-15, PHY205-15	PHY
	PHY210	Atomic Physics	3		2/Spr	PHY106	PHY
	Total		26	5.5			
Major Core Courses	PHY301	Physics Laboratory IV	3	3	3/Fall	PHY105, PHY104B	PHY
	PHY321-15	Introduction to Solid State Physics	4		3/Fall	PHY206-15	PHY
	PHY307	Modern Optics	3		3/Fall	PHY106	PHY
	PHY324	Laser Fundamentals	3		3/Spr	PHY307, PHY210	PHY
	PHY336	Introduction to Computational Physics	3		3/Spr	CS110，PHY204，PHY321-15	PHY
	PHY326-15	Semiconductor Physics and Devices	4		3/Spr	PHY321-15	PHY
	Total		20	3			
Practice-based Courses	PHY480	Scientific Innovation Project	2	2		None	PHY
	PHY485	Internship	2	2		None	PHY
	PHY490	Thesis (Graduation project)	12	12		None	PHY
	Total		16	16			
Total			62	24.5			

Note:

1. PHY203-15 "Mathematical Methods in Physics" can be replaced by complex variable function courses and partial differential equation courses. Complex variable function coursesc including MA202 "Complex Analysis" or MA232 "Complex Analysis (H)", and partial differential equation courses including MA303 "Partial Differential Equations" or MA336 "Partial Differential Equations(H)".
2. PHY307 "Modern Optics" can be replaced by optical fundamentals courses (including EE210 "Fundamentals of Optics").
3. PHY336 "Introduction to Computational Physics" can be replaced by numerical calculation courses (including ESS205 "Computational Methods" or MA305 "Numerical Analysis").
4. Students can start their Scientific Innovation Project after the first academic year. The minimum credit hours of the project are 64.
5. Students are recommended to carry out the internship in the summer semester of the third academic year by registering for the corresponding courses from Department of Electrical and Electronic Engineering or Department of Materials Science and Engineering, and finish the courses under the corresponding requirements.
6. When choosing course alternatives, attention should be paid to the requirements of the prerequisite courses for the relevant courses, as well as differences in content and difficulty. After the course is replaced, no additional

credits will be recognized for the relevant courses. The rules for credit recognition and replacement are interpreted by the Teaching Steering Committee of the Department of Physics.

Table 2: Major Elective Courses

Program of Applied Physics

Course Category	Course Code	Course Name	Credits	Practice-based Learning Credits	Terms	Prerequisite	Dept.
Mathematics	MA109	Advanced Linear Algebra	4		1/Spr	MA113	MATH
	MA212	Probability and Statistics	3		2/Fall	MA127	MATH
	MA327	Differential Geometry	3		3/Spr	MA201a/MA201b	MATH
	MA321	Representations of Groups	3		3/Fall	MA214/MA219	MATH
	MA323	Topology	3		3/Fall	MA214/MA219	MATH
Computer	ME112	Introduction to Matlab	2	1	1/Spr	None	ME
	CS205	C/C++ Program Design	3	1	2/Fall	None	CSE
	CS203B	Data Structures and Algorithm Analysis B	3	1	2/Fall	CS102A	CSE
	CS301	Embedded System and Microcomputer Principle	3	1	3/Fall	CS207	CSE
	CS303B	Artificial Intelligence B	3	1	3/Fall	CS110, CS203B, MA212	CSE
	CS405	Machine Learning	3	1	4/Fall	MA113, MA212	CSE
Mechanical & Electronic	EE104	Fundamentals of Electric Circuits	2		1/Spr	MA127, MA113 or MA107B	EE
	EE201-17	Analog Circuits	3		2/Fall	PHY106, EE104	EE
	EE201-17L	Analog Circuits Laboratory	1	1	2/Fall	EE201-17	EE
	EE202-17	Digital Circuits	3		2/Spr	PHY106	EE
	EE202-17L	Digital Circuits Laboratory	1	1	2/Spr	EE202-17	EE
Physical Experiments and Applications	PHY401	Virtual Experiments on Frontiers of Physics	1	1	2/Spr	PHY104B	PHY
	PHY330	Solid Optoelectronics	3		3/Spr	PHY206-15, PHY307	PHY
	PHY5054	Introduction to Surface Physics	3		3/Spr	PHY321-15	PHY
	PHY328	Low Temperature Physics	3	1	3/Spr	PHY204	PHY
	PHY5010	Physics of Thin Films	3		4/Fall	PHY321-15, PHY204	PHY
	PHY425	Modern Techniques in Materials Characterization	3	1	4/Fall	PHY206-15	PHY
	PHY5031	Introduction to Microelectronic Fabrication	2	1	4/Fall	CH105, PHY106	PHY
	PHY5013	Advanced Electron Microscopy	3	1	4/Fall	PHY321-15	PHY
	PHY5060	Experimental Methods in Nuclear Physics	3		4/Fall	PHY106	PHY
	PHY5055	Information Optics	3		4/Fall	PHY106	PHY
Physical Theory	PHY208	Electrodynamics II	3		2/Spr	PHY207-15	PHY
	PHY305	Quantum Mechanics II	3		3/Fall	PHY206-15	PHY
	PHY303	Statistical Mechanics II	3		3/Fall	PHY204	PHY

	ESS314	Fundamentals of Plasma Physics	4		3/Fall	PHY203-15	ESS
	MAE303	Fluid Mechanics	4		3/Fall	MA127, PHY106	MAE
	MAE304	Elasticity	4		3/Spr	MAE203, MAE202	MAE
	PHY5001	Advanced Quantum Mechanics	4		4/Fall	PHY305	PHY
	PHY5011	Group Theory for Physicists	4		4/Fall	PHY206-15, MA113	PHY
	PHY439	General Relativity: from Black Holes to Cosmology	3		4/Fall	MA113, PHY205-15	PHY
	PHY5012	Quantum Information	3		4/Fall	PHY206-15	PHY
	PHY5009	Fundamentals of electronic structures and density functional theory	3		4/Fall	PHY206-15	PHY
	PHY5057	Biological Physics	3		4/Fall	PHY204	PHY
	PHY5056	Principle of Nonlinear Optics	3		4/Fall	PHY208, PHY321-15, PHY305	PHY
	PHY5051	Principles of Photonics	3		4/Spr	PHY106, MA127	PHY
	PHY5052	Cold Atom Physics	3		4/Spr	PHY210, PHY206-15	PHY
	PHY5008	Quantum Transport Theories	3		4/Spr	PHY321-15, PHY305	PHY
	PHY5030	Introduction to Quantum Field Theory	4		4/Spr	MA113	PHY
	PHY5032	Quantum Computation	3		4/Spr	MA127	PHY
	PHY5020	Quantum Optics	3		4/Spr	MA201a	PHY
	PHY5004	Advanced Solid State Physics	4		4/Spr	MA203a, MA213	PHY
Physics Comprehensive Development courses	PHYS001	Open Physics Laboratory I	1	1	1/Smr	None	PHY
	PHY221	Open Physics Laboratory II	1	1	2/Fall	PHY104B	PHY
	GE351	Scientific Literature and Writing	1		3/Fall	None	CHEM
	PHYS002	Lectures on selected Frontiers in Physics	2		3/Smr	PHY106	PHY
	PHY5028	Condensed Matter Physics Forum	3		4/Fall	PHY106	PHY
	PHY5053	Topics in Superconductivity	3		4/Fall	PHY321-15, PHY305	PHY
Total			148	15			

Note:

1. Students should report their plans of major selective courses after claiming their majors by consulting their academic advisors. The minimum credit requirement of major elective course is 14.
2. The courses whose course codes start with PHYS are summer semester courses. Dynamic course of summer semester may be changed depending on the situation.
3. Major elective courses of specific semesters may be changed according to the situation. The number of major elective courses may increase with the development of curriculum construction, please refer to the course schedule for the current year.
4. The course code starting with PHY5 is a graduate course. Students should be guided by their academic advisor and judge whether to take it based on their own abilities. At the same time, please pay attention to the relevant policies of our graduate school on credit recognition during the graduate stage.
5. Students can study chemistry, biology, materials, electronics and other courses not being listed above according to the advice of academic advisors. The corresponding credits can be counted as elective ones after the credits certification of major elective courses in Applied Physics.
6. Courses with similar content can be substituted, but credits can not be certificated repeatedly. The credit certification rules should be interpreted by the Teaching Steering Committee of the Department of Physics.

Table 3: Overview of Practice-based Learning

Program of Applied Physics

Course Code	Course Name	Credits	Practice-based Learning Credits	Terms	Prerequisite	Dept.
ME102	CAD and Engineering Drawing	3	1.5	1/Spr	None	ME
PHYS001	Open Physics Laboratory I	1	1	1/Smr	PHY104B	PHY
PHY201-15	Physics Laboratory II	2	2	2/Fall	PHY105, PHY104B	PHY
PHY221	Open Physics Laboratory II	1	1	2/Fall	PHY104B	PHY
EE201-17L	Analog Circuits Laboratory	1	1	2/Fall	EE201-17	EE
EE202-17L	Digital Circuits Laboratory	1	1	2/Spr	EE202-17	EE
PHY202	Physics Laboratory III	2	2	2/Spr	PHY105, PHY104B	PHY
PHY301	Physics Laboratory IV	3	3	3/Fall	PHY105, PHY104B	PHY
PHY328	Low Temperature Physics Laboratory	3	1	3/Spr	PHY204	PHY
PHY425	Modern Techniques in Materials Characterization Laboratory	3	1	4/Fall	PHY206-15	PHY
PHY5031	Introduction to Microelectronic Fabrication	2	1	4/Fall	CH105, PHY106	PHY
PHY5013	Advanced Electron Microscopy	3	1	4/Fall	PHY321-15	PHY
PHY480	Scientific Innovation Project①	2	2		None	PHY
PHY485	Internship②	2	2		None	PHY
PHY490	Thesis (Graduation project)	12	12		None	PHY
Total		41	32.5			

Note:

1. Students can start their Scientific Innovation Project at terms after the first academic year. The minimum credit hours of the project are 64.
2. Students are recommended to carry out the internship in the summer semester of the third academic year by registering for the corresponding courses from Department of Electrical and Electronic Engineering or Department of Materials Science and Engineering, and finish the courses under the corresponding requirements.

Curriculum Structure of Applied Physics