Department of Physics

Program of Physics for International Students (2023)

I. Introduction

Physics is one of the oldest disciplines of natural science based on experiments, which involves the studies of motions of objects ranging from subatomic to cosmic levels, and the exploring of interactions and transformations of substances. It keeps developing as human explores the Nature. Until the 17th century, the Newtonian mechanics had been established, and the laws of motion of various objects including celestial bodies were well understood. In the late 19th century, physics became a systematic and rigorous discipline that contains mechanics, thermodynamics, electromagnetism, optics, etc., known as classic physics nowadays. The modern physics was developed at the beginning of the 20th century with the establishment of relativity and quantum mechanics. Significant breakthroughs in exploring the fundamental structure of the universe were made that greatly facilitated the development of technology and pushed forward the frontier of human cognition. However, the exploration of nature is far from complete. Many fundamental problems were still not being solved, such as the motion law of celestial objects in cosmic level, a more fundamental structure of elementary particles, and the physics laws of complex and strongly correlated macroscopic materials.

Physics is closely related to many other natural science disciplines. It has been a driving force to various of subjects including mathematics, chemistry, biology, geology, materials science, and information science. In addition, physics also makes great contributions to the revolutions of new technology arising from the theoretical breakthroughs, including nuclear energy, semiconductor, superconductor, laser, aerospace industry, etc. In short, physics plays a very important role in our economy and daily life. Progresses in areas such as fusion energy, novel semiconductor materials, high temperature superconductivity, quantum information and quantum computation are expected in the foreseeable future, and these progresses will lead to the developments of many other new areas of science and technology.

Physics Department at Southern University of Science and Technology, was established in

2011. It is one of the five earliest departments in SUSTech. At present, its research fields include theoretical physics, mathematical physics, particle physics and cosmology, condensed matter physics, computational physics, quantum information and quantum computation, optics, atomic and molecular physics, Soft matter Physics and Biophysics, etc.

Academic subject areas: Physics

Program code: 070201

II. Objectives and Learning Outcomes

1. Objectives

The major provides systematic physics training for students, making them ready for advanced study and frontier research in physics and interdisciplinary disciplines in the future, as well as R&D, production, teaching and management in industrial departments, scientific research institutes and educational departments.

2. Learning Outcomes

Graduates should meet the requirements of the Ministry of Education on the ideological and political theory and moral education of undergraduates, have certain humanistic literacy, aesthetic literacy and social science knowledge, and establish correct labor values and attitudes, and meet the following professional training requirements:

1. Solid Mathematical Foundation

2. Systematically and comprehensively grasping the basic theories of Physics

3. Familiar with physics experiment methods and skills

4. Understanding the frontiers and developments of one or more research directions in physics or related majors

5. Abundant knowledge of physics and flexible application of physical theory in daily life and scientific research practice

6. Scientific Spirit, Innovative Awareness and Preliminary Scientific Research Ability

7. Basic knowledge background of related science and Engineering Majors

8. Basic computer programming, application and numerical computing capabilities

9. Ability to consult English documents, write papers and communicate academically

10. Good oral skills and teamwork spirit

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 Sciene.

3. The minimum credit requirement for graduation: 153 credits. The specific requirements are as follows.

<table>
<tr><th colspan="2">Module</th><th>Category</th><th>Minimum Credit Requirement</th></tr>
<tr><td rowspan="15">General Education Courses</td><td>Chinese Language and Culture Module</td><td>Chinese Language and Culture</td><td>16</td></tr>
<tr><td rowspan="2">Arts and Physical Education Module</td><td>Physical Education</td><td>4</td></tr>
<tr><td>Arts</td><td>2</td></tr>
<tr><td rowspan="3">Competence Development Module</td><td>Computer Programming</td><td>3</td></tr>
<tr><td>Writing</td><td>2</td></tr>
<tr><td>Foreign Languages</td><td>14</td></tr>
<tr><td rowspan="3">Humanities and Social Sciences Module</td><td>Humanities</td><td rowspan="2">6</td></tr>
<tr><td>Social Sciences</td></tr>
<tr><td>Chinese Studies</td><td>2</td></tr>
<tr><td rowspan="4">Mathematics and Natural Sciences Module</td><td>Mathematics</td><td>12</td></tr>
<tr><td>Physics</td><td>10</td></tr>
<tr><td>Chemistry</td><td>3</td></tr>
<tr><td>Geoscience + Life Science</td><td>3</td></tr>
<tr><td>GE to Majors Bridging Module</td><td>Introduction to Majors</td><td>2</td></tr>
<tr><td rowspan="4">Major Courses</td><td rowspan="3">Major Required Courses</td><td>Major Foundational Courses</td><td>26</td></tr>
<tr><td>Major Core Courses</td><td>19</td></tr>
<tr><td>Practice-based Learning (Undergraduate Thesis, Internships, Research projects, etc.)</td><td>14</td></tr>
<tr><td>Major Elective Courses</td><td>Major Elective Courses</td><td>15</td></tr>
<tr><td colspan="3">Total</td><td>153</td></tr>
<tr><td colspan="4">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.</td></tr>
</table>

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. Physics: PHY101 General Physics I , PHY102 General Physics II can replace PHY105 College Physics I, PHY106 College Physics II;
3. Chemistry: CH103 General Chemistry can replace CH105 Chemistry: The Central Science;
4. Geoscience + Life Science: BIO103 Principles of Biology can replace BIO102B Introduction to Life Sciences.
5. 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>
</table>

VI: Major Course Arrangement

Table 1: Major Required Courses

Program of Physics

Course Category	Course Code	Course Name	Credits	Practice-based Learning Credits	Terms	Prerequisite	Dept.
Major Foundational Courses	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
	PHY201-15	Physics Laboratory II	2	2	2/Fall	PHY105, PHY104B	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
	PHY208	Electrodynamics II	3		2/Spr	PHY207-15	PHY
	PHY210	Atomic Physics	3		2/Spr	PHY106	PHY
	Total		26	4			
Major Core Courses	PHY301	Physics Laboratory IV	3	3	3/Fall	PHY105, PHY104B	PHY
	PHY305	Quantum Mechanics II	3		3/Fall	PHY206-15	PHY
	PHY303	Statistical Mechanics II	3		3/Fall	PHY204	PHY
	PHY307	Modern Optics	3		3/Fall	PHY106	PHY
	PHY321-15	Introduction to Solid State Physics	4		3/Fall	PHY206-15	PHY
	PHY336	Introduction to Computational Physics	3		3/Spr	CS110, PHY204, PHY321-15	PHY
	Total		19	3			
Practice-based Courses	PHY480	Scientific Innovation Project	2	2			PHY
	PHY490	Thesis (Graduation project)	12	12			PHY
	Total		14	14			
Total			59	21			

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. 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 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
	CS303B	Artificial Intelligence B	3	1	3/Fall	CS110, CS203B, MA212	CSE
	CS405	Machine Learning	3	1	4/Fall	MA113 MA212	CSE
Mechanical & Electronic	ME102	CAD and Engineering Drawing	3	1.5	1/Spr	None	ME
	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 Theory	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	PHY206-15	PHY
	PHY5011	Group Theory for Physicists	4		4/Fall	PHY206-15, MA113	PHY
	PHY439	General Relativity: from Black Hole to Cosmology	3		4/Fall	MA113, PHY205-15	PHY
	PHY5012	Quantum Information	3		4/Fall	PHY206-15	PHY
	PHY5009	Fundamentals of electronic structure and density functional theory	3		4/Fall	PHY206-15	PHY
	PHY5008	Quantum Transport Theories	3		4/Spr	PHY321-15, PHY305	PHY
	PHY5030	Introduction to Quantum Field Theor	4		4/Spr	PHY305, PHY205-15, MA113	PHY
	PHY5032	Quantum Computation	3		4/Spr	PHY206-15	PHY
	PHY5020	Quantum Optics	3		4/Spr	PHY305	PHY
	PHY5004	Advanced Solid State Physics	4		4/Spr	PHY321-15	PHY
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
	PHY324	Laser Fundamentals	3		3/Spr	PHY307, PHY210	PHY

	PHY326-15	Semiconductor Physics and Devices	4		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
Physics Comprehensive Development courses	PHYS001	Open Physics Laboratory I	1	1	1/Smr	PHY104B	PHY
	PHY221	Open Physics Laboratory II	1	1	2/Fall	PHY104B	PHY
	GE351	Scientific Literature and Writing	1		3/Fall	None	CHEM
	PHY5028	Condensed Matter Physics Forum	3		4/Fall	PHY106	PHY
Total			123	15.5			

Note:

1. Students should report their plans of major elective courses after claiming their majors by consulting their academic advisors. The minimum credit requirement of major elective course is 15.
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 take mathematics, statistics, computer, electronics, chemistry, materials and other courses not being listed above according to the advice of academic advisors. The credits obtained can be applied for the credits certification of major elective courses in 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 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 Project[1]	2	2		None	PHY
PHY490	Thesis (Graduation project)	12	12		None	PHY
Total		39	30.5			

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.

Curriculum Structure of Physics