Department of Physics

Program of Physics for International Students (2020)

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, nanomaterials and quantum information 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, particle physics and cosmology, condensed matter physics, computational physics, quantum information and quantum computation, optics, atomic and molecular physics and biophysics (in planning), etc.

II. Objectives and Learning Outcomes

(1) Training 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) Training requirements

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 and social science knowledge, 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 physics or related majors

5. Abundant knowledge of physics and flexible application of physical theory

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 and Graduation Requirements

Study length: Four years

Degree conferred: Bachelor of Science degree

The minimum credit requirement for graduation: 133 credits (not including English courses);

Category	Module	Minimum Credit Requirement
General Education (GE) Required Courses (51 credits)	Science	31
	Physical Education	4
	Chinese Languages & Culture	16
General Education (GE) Elective Courses (10 credits)	Humanities	4
	Social Sciences	4
	Arts	2
	Science	0
Major Course (72 credits)	Major Foundational Courses	26
	Major Core Courses	19
	Major Elective Courses	17
	Research Projects, Internship and Undergraduate Thesis /Projects	10
Total (not including English courses)		133

IV. Discipline

Physics

V. Main Courses

General Physics B (I) and (II), Modern Optics, Atomic Physic, Mathematical Methods in Physics, Analytical Mechanics, Electrodynamics I and II, Thermodynamics and Statistical Physics I, Statistical Mechanics II, Introduction to Quantum Mechanics and Quantum Mechanics II, Introduction to Solid State Physics, Introduction to Computational Physics.

VI. Practice-Based Courses

See Table 3.

VII. Pre-requisites for Major Declaration

Major Declaration Time	Course Code	Course Name	Prerequisite
Declare major at the end of First Year	PHY103B	General Physics B (I)	
	PHY105B	General Physics B (II)	PHY103B
	MA101B	Calculus I A	
	MA102B	Calculus II A	MA101B
	MA107A	Linear Algebra A	
Declare major at the end of Second Year	PHY203-15	Mathematical Methods in Physics	MA102B, PHY105B, MA107A
	PHY205-15	Analytical Mechanics	PHY105B
	PHY207-15	Electrodynamics I	PHY203-15
	PHY204	Thermodynamics and Statistical Physics I	PHY105B
	PHY206-15	Introduction to Quantum Mechanics	PHY203-15, PHY205-15
	PHY210	Atomic Physics	PHY105B
	PHY201-15	Physics Laboratory II	PHY103B, PHY104B
	PHY202	Physics Laboratory III	PHY103B, PHY104B
Annotation 1: The B-level course of General Physics can be replaced by the A-level course of General Physics. Annotation 2: The A-level course of Calculus can be replaced by Mathematical Analysis. Annotation 3: The A-level course of Linear Algebra can be replaced by Advanced Linear Algebra I.			

VIII. Requirements for GE Required Courses

(I) Science Module

Course Code	Course Name	Credit	Lab Credits	Hours/week	Term	Instruction Language	Prerequisite	Dept
MA101B	Calculus I A	4		4	Spr/Fall	B/E	NA	MATH
MA102B	Calculus II A	4		4	Spr/Fall	B/E	MA101B	MATH
MA107A	Linear Algebra A	4		4	Spr/Fall	B/E	NA	MATH
PHY103B	General Physics B (I)	4		4	Spr/Fall	B/E	NA	PHY
PHY105B	General Physics B (II)	4		4	Spr/Fall	B/E	PHY103B	PHY
CH101B	General Chemistry B	3		3	Spr/Fall	B/E	NA	CHEM
BIO102B	Introduction to Life Science	3		3	Spr/Fall	B/E	NA	BIO
CS102B	Introduction to Computer Programming B	3	1	4	Spr/Fall	B/E	NA	CSE
PHY104B	Experiments of Fundamental Physics	2	2	4	Spr/Fall	B/E	NA	PHY
Total		31	3	34				

Annotation 1: The B-level course of General Physics can be replaced by the A-level course of General Physics.

Annotation 2: The A-level course of Calculus can be replaced by Mathematical Analysis.

Annotation 3: The A-level course of Linear Algebra can be replaced by Advanced Linear Algebra I.

Annotation 4: Other general courses of computer, chemistry and biology can also be replaced by higher-level courses. Among them, it is suggested to take Introduction to Computer Programming A for subsequent major elective courses. The credit increase of general courses caused by curriculum replacement cannot replace the credits of Major Required Courses and Elective Courses. Students majoring in physics still need to complete the minimum requirements of compulsory and optional courses in accordance with the regulations.

(II) Physical Education

Course Code	Course Name	Credits	Hours/week	Terms	Instruction language	Prerequisite	Dept.
GE131	Physical Education I	1	2	Fall	C	NA	PE Center
GE132	Physical Education II	1	2	Spr	C	NA	
GE231	Physical Education III	1	2	Fall	C	NA	
GE232	Physical Education IV	1	2	Spr	C	NA	
GE331	Physical Education V	0	/	Fall	C	NA	
GE332	Physical Education Ⅵ	0	/	Spr	C	NA	
GE431	Physical Education Ⅶ	0	/	Fall	C	NA	
GE432	Physical Education Ⅷ	0	/	Spr	C	NA	
Total		4	8				

Note: All physical education courses are general required courses. For Semester 1-4, each course(GE131.GE132,GE231,GE232) counted as 1 credit ; for semester 5-8,（GE331.GE332,GE431,GE432）are extracurriculum courses without no credits, details can be referred to Physical Education Curriculum Program of Sustech.

(III) Chinese Languages & Culture

Course Code	Course Name	Credit	Hours/week	Term	Instruction Language	Prerequisite	Dept
CLE008	Elementary Chinese I	2	4	1/Fall	B	NA	CLE
CLE009	Elementary Chinese II	2	4	1/Spr	B	CLE008	
CLE027	Intermediate Chinese I	2	4	2/Fall	B	CLE009	
CLE028	Intermediate Chinese II	2	4	2/Spr	B	CLE027	
CLE031	Advanced Chinese I	2	4	3/Fall	B	CLE028	
CLE032	Advanced Chinese II	2	4	3/Spr	B	CLE031	
CLE033	Chinese Culture	2	2	Spr/Fall	B/E	NA	CLE/ HUM/ SSC
CLE034	Chinese History	2	2	Spr/Fall	B/E	NA	
Total		16	28				

(IV) English Language

Students will undertake the English Placement Test and be placed into three levels according to the result of the test and their performance in the National College Entrance Exam. Students at different levels are required to take the courses with a different credit value in total.

Level A: 6 credits; SUSTech English III, and English for Academic Purposes

Level B: 10 credits; SUSTech English II, SUSTech English III, and English for Academic Purposes

Level C: 14 credits; SUSTech English I, SUSTech English II, SUSTech English III, and English for Academic Purposes.

Course Code	Course Name	Credit	Hours/week	Instruction Language	Prerequisite	Dept
CLE021	SUSTech English I	4	4	E	NA	CLE
CLE022	SUSTech English II	4	4	E	CLE021	
CLE023	SUSTech English III	4	4	E	CLE022	
CLE030	English for Academic Purposes	2	2	E	CLE023	

IX Requirements for GE Elective Courses

(I) Students are required to complete 4 credits for the Humanities Module and Social Sciences Module respectively, and 2 credits for the Music and Art Module. (Information about the available courses and the instruction language will be announced before the course selection session)

X. Major Course Arrangement

Table 1: Major Required Course (Foundational and Core Courses)

Course Category	Course Code	Course Name	Credit	Lab Credits	Hours/week	Term	Advised term to take the course	Instruction language	Prerequisite	Dept.
Major Foundational Courses	PHY203-15	Mathematical Methods in Physics	4		4	Fall	2/Fall	B	MA102B, PHY105B, MA107A	PHY
	PHY205-15	Analytical Mechanics	3		3	Fall	2/Fall	C	PHY105B	PHY
	PHY207-15	Electrodynamics I	3		3	Fall	2/Fall	C	PHY203-15	PHY
	PHY201-15	Physics Laboratory II	2	2	4	Fall	2/Fall	B	PHY103B, PHY104B	PHY
	PHY202	Physics Laboratory III	2	2	4	Spr	2/Spr	B	PHY103B, PHY104B	PHY
	PHY204	Thermodynamics and Statistical Physics I	3		3	Spr	2/Spr	B	PHY105B	PHY
	PHY206-15	Introduction to Quantum Mechanics	3		3	Spr	2/Spr	C	PHY203-15, PHY205-15	PHY
	PHY208	Electrodynamics II	3		3	Spr	2/Spr	C	PHY207-15	PHY
	PHY210	Atomic Physics	3		3	Spr	2/Spr	E	PHY105B	PHY
	Total		26	4	30					
Major Core Courses	PHY301	Physics Laboratory IV	3	3	6	Fall	3/Fall	B	PHY103B, PHY104B	PHY
	PHY305	Quantum Mechanics II	3		3	Fall	3/Fall	C	PHY206-15	PHY
	PHY303	Statistical Mechanics II	3		3	Fall	3/Fall	B	PHY204	PHY
	PHY307	Modern Optics	3		3	Fall	3/Fall	B	PHY105B	PHY
	PHY321-15	Introduction to Solid State Physics	4		4	Fall	3/Fall	B	PHY206-15	PHY
	PHY336	Introduction to Computational Physics①	3		3	Spr	3/Spr	C	CS102B, PHY204, PHY321-15	PHY
	Total		19	3	22					
Practice-based Courses	PHY480	Scientific Innovation Project②	2	2	4					PHY
	PHY490	Thesis (Graduation project)	8	8	16					PHY
	Total		10	10	20					
Total			55	17	72					

Annotation ①: PHY336 " Introduction to Computational Physics " can be replaced by ESS205 " Computational Methods".

Annotation ②: Students can start their Scientific Innovation Project at terms after the first academic year. The minimum credit hours of the project are 64.

Table 2: Major Elective Courses

Course Category	Course Code	Course Name	Credits	Lab Credits	Hours/week	Term	Advised term to take the course	Instruction language	Prerequisite	Dept.
Mathematics	MA109	Advanced Linear Algebra	4		4	Spr	1/Spr	B	MA107A	MATH
	MA212	Probability and Statistics	3		3	Fall/Spr	2/Fall	B	MA102B	MATH
	MA202	Complex Analysis	3		3	Spr	2/Spr	B	MA203a, MA213	MATH
	MA201b	Ordinary Differential Equations B	4		4	Fall/Spr	2/Spr	B	MA102B	MATH
	MA303	Partial Differential Equations	3		3	Fall	3/Fall	C/ E/ B	MA201a	MATH
	MA305	Numerical Analysis	3		3	Fall	3/Fall	C	MA203a, MA213	MATH
Computer	ME112	Introduction to Matlab	2	1	3	Spr	1/Spr	B		ME
	CS205	C/C++ Program Design	3	1	4	Fall/Spr	2/Fall	E		CSE
	CS203B	Data Structures and Algorithm Analysis B	3	1	4	Fall	2/Fall	B	CS102A	CSE
	CS303B	Artificial Intelligence B	3	1	4	Fall	3/Fall	B	CS102B, CS203B, MA212	CSE
	CS405	Machine Learning	3	1	4	Fall	4/Fall	B	MA107A, MA212	CSE
Mechanical & Electronic	ME102	CAD and Engineering Drawing	3	1.5	4.5	Fall/Spr	1/Spr	C		ME
	EE104	Fundamentals of Electric Circuits	2		2	Spr	1/Spr	B	MA102B, MA107A or MA107B	EE
	EE201-17	Analog Circuits	3		3	Fall	2/Fall	C	PHY105B, EE104	EE
	EE201-17L	Analog Circuits Laboratory	1	1	2	Fall	2/Fall	C	EE201-17	EE
	EE202-17	Digital Circuits	3		3	Spr	2/Spr	C	PHY105B	EE
	EE202-17L	Digital Circuits Laboratory	1	1	2	Spr	2/Spr	C	EE202-17	EE
Physical Theory	ESS314	Fundamentals of Plasma Physics	4		4	Fall	3/Fall	E	PHY203-15	ESS
	MAE303	Fluid Mechanics	4		4	Fall	3/Fall	E	MA102B, PHY105B	MAE
	MAE304	Elasticity	4		4	Spr	3/Spr	C	MAE203 MAE202	MAE
	PHY435	Advanced Quantum Mechanics	4		4	Fall	4/Fall	E	PHY206-15	PHY
	PHY437	Group Theory for Physicists	4		4	Fall	4/Fall	C	PHY206-15, MA107A	PHY
	PHY439	General Relativity: from Black Holes to Cosmology	3		3	Fall	4/Fall	E	MA107A, PHY205-15	PHY
	PHY441	Quantum Information	3		3	Fall	4/Fall	E	PHY206-15	PHY
	PHY431	Quantum Transport Theories	3		3	Spr	4/Spr	B	PHY321-15, PHY305	PHY
	PHY443	Introduction to Quantum Field Theory	4		4	Spr	4/Spr	E	PHY305, PHY205-15, MA107A	PHY

	PHY442	Quantum Computation	3		3	Spr	4/Spr	E	PHY206-15	PHY
Physical Experiments and Applications	PHY401	Virtual Experiments on Frontiers of Physics	1	1	2	Fall/Spr	2/Spr	B	PHY104B	PHY
	PHY330	Solid Optoelectronics	3		3	Spr	3/Spr	E	PHY206-15, PHY307	PHY
	PHY332-15	Surface Physics	4		4	Spr	3/Spr	B	PHY321-15	PHY
	PHY324	Laser Fundamentals	3		3	Spr	3/Spr	C	PHY307, PHY210	PHY
	PHY326-15	Semiconductor Physics and Devices	4		4	Spr	3/Spr	B	PHY321-15	PHY
	PHY328	Low Temperature Physics	3	1	4	Spr	3/Spr	B	PHY204	PHY
	PHY423-15	Physics of Thin Films	3		3	Fall	4/Fall	E	PHY321-15, PHY204	PHY
	PHY425	Modern Techniques in Materials Characterization	3	1	4	Fall	4/Fall	B	PHY206-15	PHY
	PHY427	Introduction to Microelectronic Fabrication	2	1	3	Fall	4/Fall	E	CH101B, PHY105B	PHY
	PHY429	Advanced Electron Microscopy	3	1	4	Fall	4/Fall	E	PHY321-15	PHY
Physics Comprehensive Development courses	PHYS001	Open Physics Laboratory I	1	1	8	Smr	1/Smr	B	PHY104B	PHY
	PHY221	Open Physics Laboratory II	1	1	2	Fall	2/Fall	B	PHY104B	PHY
	GE351	Scientific Literature and Writing	1		1	Fall	3/Fall	C		GE
	PHYS002	Lectures on selected Frontiers in Physics	2		8	Smr	3/Smr	C	PHY105B	PHY
	PHY433	Condensed Matter Physics Forum	3		3	Fall	4/Fall	B	PHY105B	PHY
Dynamic Course of Summer semester	PHYS003	Numerical Algorithms in Physics	1		4	Smr	3/Smr	C	PHY321-15, MA305 or PHY336	PHY
	PHYS004	Energy transfer in photosynthesis and molecular crystals	1		4	Smr	3/Smr	C		PHY
	PHYS005	Crystal Structures and Symmetry Groups	1		4	Smr	3/Smr	C		PHY
	PHYS006	Science and Society	1		4	Smr	3/Smr	C		PHY
	PHYS007	Introduction to differential geometry	1		4	Smr	3/Smr	C	MA102B, MA107A, PHY208	PHY
	PHYS008	Frontier of Quantum Information Science	1		4	Smr	3/Smr	B	PHY206-15	PHY
	PHYS009	Semiconductor Quantum Technologies	1		4	Smr	3/Smr	B	PHY206-15, PHY321-15	PHY
Total			127	15.5	175.5					

Annotation 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 17.

Annotation 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.

Annotation 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.

Annotation 4: Students can take mathematics, 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.

Annotation 5: MA109 " Advanced Linear Algebra " can be replaced by MA111 " Advanced Linear Algebra II ".

Table 3: Overview of Practice-Based Courses

Course Code	Course Name	Credit	Lab Credits	Hours/week	Term	Advised term to take the course	Instruction language	Prerequisite	Dept.
ME102	CAD and Engineering Drawing	3	1.5	4.5	Spr& Fall	1/Spr	C		ME
PHYS001	Open Physics Laboratory I	1	1	8	Smr	1/Smr	B	PHY104B	PHY
PHY201-15	Physics Laboratory II	2	2	4	Fall	2/Fall	B	PHY103B, PHY104B	PHY
PHY221	Open Physics Laboratory II	1	1	2	Fall	2/Fall	B	PHY104B	PHY
EE201-17L	Analog Circuits Laboratory	1	1	2	Fall	2/Fall	C	EE201-17	EE
EE202-17L	Digital Circuits Laboratory	1	1	2	Spr	2/Spr	C	EE202-17	EE
PHY202	Physics Laboratory III	2	2	4	Spr	2/Spr	B	PHY103B, PHY104B	PHY
PHY301	Physics Laboratory IV	3	3	6	Fall	3/Fall	B	PHY103B, PHY104B	PHY
PHY328	Low Temperature Physics Laboratory	3	1	4	Spr	3/Spr	B	PHY204	PHY
PHY425	Modern Techniques in Materials Characterization Laboratory	3	1	4	Fall	4/Fall	B	PHY206-15	PHY
PHY427	Introduction to Microelectronic fabrication Laboratory	2	1	3	Fall	4/Fall	E	CH101B, PHY105B	PHY
PHY429	Advanced Electron Microscopy Laboratory	3	1	4	Fall	4/Fall	E	PHY321-15	PHY
PHY480	Scientific Innovation Project①	2	2	4					PHY
PHY490	Thesis (Graduation project)	8	8	16					PHY
Total		35	26.5	67.5					

Annotation ①: Students can start their Scientific Innovation Project at terms after the first academic year. The minimum credit hours of the project are 64.

Table 4: Overview of Course Hours and Credits

Course Category	Total Course Hours	Total Credits	Credit Requirements	Percentage of the Total*
/General Education (GE) Required Courses (not including English courses)	864	51	51	38.3%
General Education (GE) Elective Courses	/	/	10	7.5%
Major Foundational Courses	480	26	26	19.5%
Major Core Courses	352	19	19	14.3%
Major Elective Courses	2280	127	17	12.8%
Research Projects, Internship and Undergraduate Thesis/Projects	320	10	10	7.5%
Total (not including English courses)	4296	233	133	/

* Percentage of the total= Credit requirements of each line / Total credit requirements

Curriculum Structure of Physics