Department of Physics

Program of Applied Physics for International Students (2021)

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.

II. Objectives and Learning Outcomes

(1) Training 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) Training requirements

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 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	20
	Major Elective Courses	14
	Research Projects, Internship and Undergraduate Thesis /Projects	12
Total (not including English courses)		133

IV. Discipline

Applied Physics

V. Main Courses

Mathematical Methods in Physics, Analytical Mechanics, Electrodynamics, Thermodynamics and Statistical Physics, Quantum Mechanics, Atomic Physics, Introduction to Solid State Physics, Modern Optics, Introduction to Computational Physics, Semiconductor Physics and Devices, Laser Fundamentals.

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 Applied 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	2	Fall	C	NA	
GE332	Physical Education Ⅵ	0	2	Spr	C	NA	
Total		4	12				

GE131、GE132、GE231、GE232、GE331、GE332 are required PE courses offered by Center For Physical Education. Students are required to select a specific sport program each semester. Student who meets the exemption conditions stated in "SUSTech Physical Education Course Exemption Regulation" can apply for exemption from GE331 and GE332.

(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	

(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: 8 credits; SUSTech English III, English for Academic Purposes and 2-credit CLE elective course

Level B: 12 credits; SUSTech English II, SUSTech English III, English for Academic Purposes, and 2-credit CLE elective course

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

List of English Language Courses

Course Code	Course Name	Credit	Hours/week	Instruction Language	Prerequisite	Dept	Notes
CLE021	SUSTech English I	4	4	E	NA	CLE	Required
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		
/	(at least one 2-credit CLE elective course)	2	2	E	CLE030		Level A & B Required

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	ME102	CAD and Engineering Drawing	3	1.5	4.5	Spr/ Fall	1/Spr	B		ME
	PHY201-15	Physics Laboratory II	2	2	4	Fall	2/Fall	B	PHY103B, PHY104B	PHY
	PHY203-15	Mathematical Methods in Physics①	4		4	Fall	2/Fall	B	MA102B, PHY105B, MA107A	PHY
	PHY205-15	Analytical Mechanics	3		3	Fall	2/Fall	B	PHY105B	PHY
	PHY207-15	Electrodynamics I	3		3	Fall	2/Fall	B	PHY203-15	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	B	PHY203-15, PHY205-15	PHY
	PHY210	Atomic Physics	3		3	Spr	2/Spr	E	PHY105B	PHY
	Total		26	5.5	31.5					
Major Core Courses	PHY301	Physics Laboratory IV	3	3	6	Fall	3/Fall	B	PHY103B, PHY104B	PHY
	PHY321-15	Introduction to Solid State Physics	4		4	Fall	3/Fall	B	PHY206-15	PHY
	PHY307	Modern Optics	3		3	Fall	3/Fall	B	PHY105B	PHY
	PHY324	Laser Fundamentals	3		3	Spr	3/Spr	B	PHY307, PHY210	PHY
	PHY336	Introduction to Computational Physics②	3		3	Spr	3/Spr	B	CS102B, PHY204, PHY321-15	PHY
	PHY326-15	Semiconductor Physics and Devices	4		4	Spr	3/Spr	B	PHY321-15	PHY
	Total		20	3	23					
Practice-based Courses	PHY480	Scientific Innovation Project③	2	2	4					PHY
	PHY485	Internship④	2	2	4					PHY
	PHY490	Thesis (Graduation project)	8	8	16					PHY
	Total		12	12	24					
Total			58	20.5	78.5					

Annotation ①: Students who have taken MA202 Complex Analysis and ESS203 Mathematical Equation can apply for exemption from PHY203-15 Mathematical Methods in Physics.

Annotation ②: PHY336 " Introduction to Computational Physics " can be replaced by ESS205 " Computational Methods ".

Annotation ③: Students can start their Scientific Innovation Project after the first academic year. The minimum credit hours of the project are 64.

Annotation ④: 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.

Table 2: Major Elective Courses

Course Category	Course Code	Course Name	Credit	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
	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
	CS301	Embedded System and Microcomputer Principle	3	1	4	Fall	3/Fall	B	CS207	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	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 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
	PHY5025	Surface Physics	4		4	Spr	3/Spr	B	PHY321-15	PHY
	PHY328	Low Temperature Physics	3	1	4	Spr	3/Spr	B	PHY204	PHY
	PHY5010	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

	PHY5031	Introduction to Microelectronic Fabrication	2	1	3	Fall	4/Fall	E	CH101B, PHY105B	PHY
	PHY5013	Advanced Electron Microscopy	3	1	4	Fall	4/Fall	E	PHY321-15	PHY
Physical Theory	PHY208	Electrodynamics II	3		3	Spr	2/Spr	C	PHY207-15	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
	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
	PHY5001	Advanced Quantum Mechanics	4		4	Fall	4/Fall	E	PHY305	PHY
	PHY5011	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
	PHY5012	Quantum Information	3		3	Fall	4/Fall	E	PHY206-15	PHY
	PHY5009	Fundamentals of electronic structures and density functional theory	3		3	Fall	4/Fall	C	PHY206-15	PHY
	PHY5008	Quantum Transport Theories	3		3	Spr	4/Spr	B	PHY321-15, PHY305	PHY
	PHY5030	Introduction to Quantum Field Theory	4		4	Spr	4/Spr	E	PHY305，PHY205-15，MA107A	PHY
	PHY5032	Quantum Computation	3		3	Spr	4/Spr	E	PHY206-15	PHY
	PHY5020	Quantum Optics	3		3	Spr	4/Spr	B	PHY305	PHY
	PHY5004	Advanced Solid State Physics	4		4	Spr	4/Spr	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
	PHY5028	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			132	15	180					

Annotation 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.

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 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.

Annotation 5: 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 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	Fall/ Spr	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
PHY5031	Introduction to Microelectronic Fabrication	2	1	3	Fall	4/Fall	E	CH101B, PHY105B	PHY
PHY5013	Advanced Electron Microscopy	3	1	4	Fall	4/Fall	E	PHY321-15	PHY
PHY480	Scientific Innovation Project①	2	2	4					PHY
PHY485	Internship②	2	2	4					PHY
PHY490	Thesis (Graduation project)	8	8	16					PHY
Total		37	28.5	71.5					

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.

Annotation 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.

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	504	26	26	19.5%
Major Core Courses	368	20	20	15.0%
Major Elective Courses	2352	132	14	10.5%
Research Projects, Internship and Undergraduate Thesis/Projects	384	12	12	9.0%
Total (not including English courses)	4472	241	133	/

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

Curriculum Structure of Applied Physics