Department of Earth and Space Sciences

Program of Geophysics for International Students (2022)

I. Introduction

Geophysics is a subject of natural science which applies the principles and methods in physics to the study of the Earth and its surrounding space environment and planets. It explores their structure, composition, formation, and evolution and studies the various natural phenomena happening in the systems. The core research areas include Earth Geophysics, Space Science and Technology, and Planetary Science. The discipline values both theoretical and applied studies. These studies not only improve our scientific understanding of the Earth's and planets' structure and the physics behind various natural phenomena, but also support defense sector, natural disaster prevention, and many industrial and high-tech sectors important to the national economic development, such as Monitor nuclear explosions, prediction and prevention of natural disasters such as earthquakes, volcanoes, landslides, rock bursts, solar storms, oil and gas exploration, metallic and nonmetallic mineral mining, underground space exploration such as water, roads, urban construction, etc.

Academic subject areas: Geophysics (0708); Program code: 070801

II. Objectives and Learning Outcomes

1. Objectives

The program is aimed to cultivate students with systematic theoretical knowledge and experimental skills in geophysics. Graduates are expected to develop a prudent work and research attitude, the ability of self-study, and the innovation and entrepreneurial spirit needed for advancing modern science and technology.

2. Learning Outcomes

（1）At graduation, students should have a solid foundation in mathematics and physics, master a foreign language, and have the ability to apply computer technology to solve practical problems;

（2）Understand and master the basic theories, basic knowledge and basic skills of geophysics;

（3）Be capable of the thinking methods and basic skills of scientific research, and have the ability to analyze, propose and solve practical problems;

（4）Have strong organizational management, communication and teamwork skills;

（5）Have wide knowledge, strong adaptability, can adapt to the needs of many aspects of modern society.

III. Study Length, Degree, and Graduation Requirements

1. Study length: 4 years. The academic credit system of SUSTech allows flexible study years, but not less than 3 years or more than 6 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: 149 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 rowspan="2">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="4">Competence Development Module</td><td>Computer Programming</td><td>3</td></tr>
<tr><td>Writing</td><td>2</td></tr>
<tr><td>Chinese Studies</td><td>2</td></tr>
<tr><td>Foreign Languages</td><td>14</td></tr>
<tr><td rowspan="2">Humanities and Social Sciences Module</td><td>Humanities</td><td rowspan="2">6</td></tr>
<tr><td>Social Sciences</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>Biology</td><td>3</td></tr>
<tr><td>Introduction to Majors 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>23</td></tr>
<tr><td>Major Core Courses</td><td>15</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>18</td></tr>
<tr><td colspan="3">Total</td><td>149</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 & Chinese Studies & Writing）, Humanities and Social Sciences Module, and Introduction to Majors Module.</td></tr>
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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/ MA101a	Calculus I / Mathematical Analysis I	4/5	1 Fall	None	Department of Mathematics
	MA127/ MA102a	Calculus II / Mathematical Analysis II	4/5	1 Spring	Calculus I / Mathematical Analysis I	
	MA113/ MA107	Linear Algebra / Advance Linear Algebra I	4	1 Spring & Fall	None	
Physics	PHY105/ PHY101	College Physics I / General Physics I	4/5	1 Fall	None	Department of Physics
	PHY106/ PHY102	College Physics II / General Physics II	4/5	1 Spring	College Physics I / General Physics I	
	PHY104B	Experiments of Fundamental Physics	2	1-2 Spring & Fall	None	
Chemistry	CH105/ CH103	Chemistry: The Central Science / General Chemistry	3/4	1-2 Spring & Fall	None	Department of Chemistry
Biology	BIO102B/ BIO103	Introduction to Life Science / Principles of Biology also meet the condition	3	1-2 Spring & Fall	None	Department of Biology
Computer Programming	CS109/ CS110/ CS111/ CS112 CS113	Introduction to Computer Programming/ Introduction to Java Programming/ Introduction to C Programming/ Introduction to Python Programming/ Introduction to Matlab Programming	3	1-2 Spring & Fall	None	Department of Computer Science and Engineering

V. Prerequisites for Major Declaration

Major Declaration Time	Course Code	Course Name	Prerequisite
Declare major at the end of the first academic year	MA117/ MA101a	Calculus I / Mathematical Analysis I	None
	MA113/ MA107	Linear Algebra / Advance Linear Algebra I	None
	PHY105/ PHY101	College Physics I / General Physics I	None
Declare major at the end of the second academic year	MA117/ MA101a	Calculus I / Mathematical Analysis I	None
	MA127/ MA102a	Calculus II / Mathematical Analysis II	Calculus I / Mathematical Analysis I
	PHY105/ PHY101	College Physics I / General Physics I	None
	PHY105/ PHY101	College Physics I / General Physics I	None
	PHY106/ PHY102	College Physics II / General Physics II	College Physics I / General Physics I
	PHY104B	Experiments of Fundamental Physics	None

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).**

VI: Major Course Arrangement

Table 1: Major Required Courses

Program of Geophysics

Course Category	Course Code	Course Name	Credits	Practice-based Learning Credits	Terms	Prerequisite	Dept.
Major Foundational Courses	ESS201	Introduction to Earth and Space Sciences	3		2 Fall	None	ESS
	MAE203B	Engineering Mechanics I – Statics and Dynamics	3		2 Fall	None	MAE
	MA212	Probability and Statistics	3		2 Fall	None	MATH
	PHY203-15	Mathematical Methods in Physics	4		2 Spr	None	PHY
	ESS213	Continuum Mechanics	3		2 Spr	None	ESS
	ESS205	Computational Methods	3		3 Fall	None	ESS
	ESS206	Fundamentals of Signal Processing and Data Analysis	4		3 Fall	None	ESS
	Total		23				
Major Core Courses	ESS102	Principles of Geology	3		2 Fall	None	ESS
	ESS209	Principles of Geophysics	3		2 Fall	None	ESS
	ESS211	Fundamentals of Planetary Science	3		2 Fall	None	ESS
	ESS214	Principles of Applied Geophysics	3		2 Spr	None	ESS
	ESS210	Fundamentals of Space Science and Technology	3		2 Spr	None	ESS
	Total		15				
Practice-based Courses	ESS480	Projects of Science and Technology Innovation	2	2	2 Fall-4 Fall	None	ESS
	ESS491	Graduation Thesis/Projects	12	12	4 Spr	None	ESS
	Total		14				
Total			52				

Notes:

1. PHY205-15 Analytical Mechanics can replace MAE203B Engineering Mechanics I – Statics and Dynamics;
2. MAE314 Advanced Numerical Methods or MA305 Numerical Analysis can replace ESS205 Computational Methods ;
3. MA204 Mathematical Statistics can replace MA212 Probability and Statistics.

Table 2: Major Elective Courses

Program of Geophysics

Course Code	Course Name	Credits	Practice-based Learning Credits	Terms	Prerequisite	Dept.
ESS208	Introduction to Natural Disaster Science	2		2 Fall	None	ESS
ESS483	Research and Innovation Practice	2	2	2 Fall-4 Spr	None	ESS
ESS204	Fundamentals of Astronomy	3		2 Spr	None	ESS
PHY204	Thermodynamics and Statistical Physics I	3		2 Spr	College Physics II	PHY
OCE407	Mineralogy and Petrology	2		2 Spr	None	OCE
OCE408	Mineralogy and Petrology Laboratory	1	1	2 Spr	Mineralogy and Petrology	OCE
EE104	Fundamentals of Electric Circuits	2		2 Spr	Calculus I and Linear Algebra	EE
CS202	Computer Organization	3	1	2 Spr	Digital Logic or Digital Circuits	CSE
ESS470	Geology Field Trips	2	2	2 Smr	Principles of Geology or Mineralogy and Petrology	ESS
ESS318	Introduction to Algorithm	3		3 Fall	None	ESS
ESS317	Fundamentals of Inverse Theory in Geophysics	3		3 Fall	None	ESS
ESS308	Fundamentals of Geophysics I (Seismology)	3		3 Fall	Calculus I and Linear Algebra	ESS
ESS309	Fundamentals of Geophysics II (Geomagnetism, Geoelectricity, Geothermics and Gravity)	4		3 Fall	Calculus I	ESS
ESS314	Fundamentals of Plasma Physics	4		3 Fall	Mathematical Methods in Physics	PHY
PHY207-15	Electrodynamics I	3		3 Fall	College Physics II, Linear Algebra and Mathematical Methods in Physics	PHY
ESS303	Fundamentals of Space Geodetics	3		3 Fall	Calculus I and Linear Algebra	ESS
PHY201-15	Physics Laboratory II	2	2	3 Fall	College Physics I and Experiments of Fundamental Physics	PHY
PHY307	Modern Optics	3		3 Fall	College Physics II	PHY
CS303B	Artificial Intelligence B	3	1	3 Fall	Probability and Statistics, Introduction to Computer Programming and Data	CSE

					Structures and Algorithm Analysis	
MA303	Partial Differential Equations	3		3 Fall	Ordinary Differential Equations B	MATH
ESS406	Geochemistry	2		3 Spr	None	ESS
MA333	Introduction to Big Data Science	3		3 Spr	Probability and Statistics	MATH
ESS419	Professional Writing and Presentation in Earth Sciences	2		3 Spr	None	ESS
ESS322	Introduction to Catastrophe Risk Modelling	2		3 Spr	Probability and Statistics and Introduction to Computer Programming	ESS
ESS323	Seismic Exploration	3		3 Spr	Calculus I and Linear Algebra	ESS
ESS423	Rock Physics	3		3 Spr	None	ESS
ESS411	Computational Space Physics	2		3 Spr	Introduction to Computer Programming	ESS
ESS408	Space Sciences Instrumentation	3	1	3 Spr	College Physics II	ESS
ESS421	Gravity and Earth tide	3		3 Spr	Calculus I and Linear Algebra	ESS
EE210	Fundamentals of Optics	3		3 Spr	None	EE
PHY202	Physics Laboratory III	2	2	3 Spr	College Physics I and Experiments of Fundamental Physics	PHY
MA325	Numerical Solution of Partial Differential Equations	3		3 Spr	Partial Differential Equations	MATH
ESS471	Geophysics Field Trips	2	2	3 Smr	Introduction to Earth and Space Sciences	ESS
ESS420	Scientific Application of Artificial Intelligence	3		4 Fall	Introduction to Computer Programming and Linear Algebra	ESS
ESS310	Geophysical Experiments	3	2	4 Fall	Introduction to Earth and Space Sciences	ESS
ESS414	Fundamentals of Geodynamics	3		4 Fall	Calculus I and College Physics I	ESS
ESS417	Seismic Data Processing and Interpretation	3	1	4 Fall	None	ESS
ESS415	Fundamentals of Tectonics	3		4 Fall	None	ESS
ESS418	Environment and Engineering Geophysics	3		4 Fall	None	ESS
ESS409	Introduction to Space Weather	3		4 Fall	None	ESS
ESS410	Magnetospheric physics	3		4 Fall	None	ESS
ESS5031	Physics of Earth and Planetary Interiors	3		4 Fall	Calculus II and College Physics II	ESS
Total		137	21			

Notes:
The minimum requirement is 18 credits for a student. ESS5031 Physics of Earth and Planetary Interiors is graduate level courses, which can be selected by undergraduates with spare ability, and the credits are included in major elective courses.

Table 3: Overview of Practice-based Learning

Program of Geophysics

Course Code	Course Name	Credits	Practice-based Learning Credits	Terms	Prerequisite	Dept.
CS109	Introduction to Computer Programming	3	1	1-2 Spring & Fall	None	CSE
CS110	Introduction to Java Programming	3	1	1-2 Spring & Fall	None	CSE
CS111	Introduction to C Programming	3	1	1-2 Spring & Fall	None	CSE
CS112	Introduction to Python Programming	3	1	1-2 Spring & Fall	None	CSE
CS113	Introduction to Matlab Programming	3	1	1-2 Spring & Fall	None	CSE
PHY104B	Experiments of Fundamental Physics	2	2	1-2 Spring & Fall	None	PHY
OCE408	Mineralogy and Petrology Laboratory	1	1	2 Spr	Mineralogy and Petrology	OCE
CS202	Computer Organization	3	1	2 Spr	Digital Logic or Digital Circuits	CSE
ESS470	Geology Field Trips	2	2	2 Smr	Principles of Geology or Mineralogy and Petrology	ESS
PHY201-15	Physics Laboratory II	2	2	3 Fall	College Physics I and Experiments of Fundamental Physics	PHY
CS303B	Artificial Intelligence B	3	1	3 Fall	Probability and Statistics, Introduction to Computer Programming and Data Structures and Algorithm Analysis	CSE
ESS408	Space Sciences Instrumentation	3	1	3 Spr	College Physics II	ESS
PHY202	Physics Laboratory III	2	2	3 Spr	College Physics I and Experiments of Fundamental Physics	PHY
ESS471	Geophysics Field Trips	2	2	3 Smr	Introduction to Earth and Space Sciences	ESS

ESS310	Geophysical Experiments	3	2	4 Fall	Introduction to Earth and Space Sciences	ESS
ESS417	Seismic Data Processing and Interpretation	3	1	4 Fall	None	ESS
ESS480	Research Projects	2	2	2 Fall-4 Fall	None	ESS
ESS491	Graduation Thesis/Projects	12	12	4 Spr	None	ESS
Total		55	36			

Curriculum Structure of Geophysics