TiGP
ACADEMIA SINICA
Taiwan International Graduate Program

Earth System Science Program (ESS)

Introduction

Academia Sinica established the Taiwan International Graduate Program (TIGP) in collaboration with a consortium of key national research universities in Taiwan. The purpose of this program is to develop a pool of highly capable researchers across various fields to establish a multidisciplinary framework that will enhance innovation and academic research standards in these and related fields thereby ensuring the future economic and social development of Taiwan.

TIGP offers Ph.D. programs in selected disciplines agreed upon by Academia Sinica and its collaborating national research universities. The program offers Ph.D. degree programs in inter-disciplinary areas including: the physical sciences, applied sciences, engineering, biological and agricultural sciences, earth system sciences, health and medical sciences, and humanities and social sciences.

Academia Sinica has assumed principal oversight of the academic options included in the program. It provides intellectual leadership, research resources, and physical facilities. Qualified and interested faculty members of participating national research universities are invited to join the various programs as the program's affiliated faculty, and participate in the teaching of courses, supervision of research, and mentoring of international graduate students.

The TIGP Program on "Earth System Science"

Earth System Science focuses on our understanding of the inter-dependence and inter-connectedness of Earth's fundamental components: the lithosphere, atmosphere, hydrosphere, and biosphere. It examines interactions among chemical, physical, biological, and dynamic processes over spatial scales from the sub-micron to the size of the planets, and over time scales of less than a second to billions of years. The phenomena involved are frequently not only intellectually challenging but also socio-economically relevant and significant. At Academia Sinica, the research interests of scientists in this field are far ranging, including the evolution of the Earth's atmosphere, anthropogenic impacts on regional climate, changes in the biogeochemistry of the ocean and global climate in response to the increase in atmospheric CO2, the effects of atmospheric processes on ocean biogeochemistry, changes in fluvial input to the oceans under climate change, the physical and chemical processes that govern the dynamic evolution of the solid Earth, the processes occurring within the lithosphere, especially those operating around subduction zones, within orogenic belts, and in the lower part of the continental crust, the mechanism and wave propagation of earthquakes, transport and fate of atmospheric pollutants, and the health risks of environmental contaminants. We welcome young inquisitive minds to join us in exploring these interesting phenomena in our Earth Science System Ph.D. program.

Faculty Members

Academia Sinica Research Center for Environmental Changes

Dr. Pao-Kuan Wang
Ph.D., University of California, Los Angeles
Cloud Physics and Dynamics, Meteorology

Dr. Fuh-Kwo Shiah
Ph.D., Marine, Estuarine and Environmental Sciences Program
University of Maryland, College Park
Microbial ecology, Planktonic tropho-dynamics, Biological Oceanography

Dr. Huang-Hsiung Hsu
Ph.D., University of Washington
Climate variation and change

Dr. Shih-Chun Candice Lung
Sc.D., Harvard School of Public Health
Exposure and risk assessment, Organic aerosols, Aerosol source apportionment

Dr. Charles C.-K. Chou
Ph.D., National Central University
Physico-chemical characterization of atmospheric aerosols, Air quality monitoring and management

Dr. Danie Mao-Chang Liang
Ph.D., California Institute of Technology
Atmospheric photochemistry, Biogeochemical cycles of nitrogen andcarbon, Astrobiology

Dr. Chih-Chung Chang
Ph.D., National Tsing Hua University
Instrumental analysis, Analysis of volatile organic compounds, Atmospheric ozone chemistry

Dr. Chuan-Yao Lin
Ph.D., National Central University
Air quality,Mesoscale Meteorology, Regional Climate Change, Urban heat island effect

Dr. Tung-Yuan Ho
Ph.D., State University of New York at Stony Brook
Marine Biogeochemistry, Marine Organic Geochemistry, Environmental Chemistry, Environmental Analytical Chemistry

Dr. Shih-Yu Lee
Ph.D., University of Michigan
Climate Dynamics, Paleoceanography, Geological Surface Process, Climate Interaction

Dr. Yi-Chia Hsin
Ph.D., National Taiwan Normal University
Physical oceanography, Multi-scale numerical ocean modeling, Dynamical studies on currents around Taiwan and equatorial currents, Development of coupling model

Dr. Wei-Liang Lee
Ph.D., Atmospheric Sciences, University of California, Los Angeles
Topographic effect on surface radiation budget, 3-D radiative transfer program, Radiative transfer in the coupled atmosphere-ocean system, Physical parameterizations in general circulation models (GCM)

Dr. Chia-Ying, Anderin, Chuang
Ph.D. Oceanography, Texas A&M University
Marine Radiochemistry, Marine Organic biogeochemistry

Institute of Earth Sciences

Dr. Lou-Chuang Lee
Ph.D., California Institute of Technology
Space Physics

Dr. Benjamin Fong Chao
Ph.D., University of California, San Diego
Earth/Planetary rotation dynamics and gravitational variations, Global changes in geophysical fluids,
Global geophysics and seismology, Digital data analysis and inverse/inference theories

Dr. Bor-Shouh Huang
Ph.D., National Central University
Seismology, Geophysics, Geosciences

Dr. Sun-Lin Chung
Ph.D., National Taiwan University
Igneous Petrogenesis; Chemical Geodynamics; East Asia Tectonics

Dr. Jian-Cheng Lee
Ph.D., Université Pierre et Marie Curie
Geodynamic, Computer Earth Science, Remote sensing, Morpho-structural Geology

Dr. Cheng-Horng Lin
Ph.D., Rensselaer Polytechnic Institute
Seismology, Tectonics

Dr. Yu-Chang Chan
Ph.D., University of Connecticut
Neotectonics, Structural Geology, Geomorphology

Dr. Wu-Cheng Chi
Ph.D., University of California at Berkeley
Ocean-Bottom Seismology, Seismic Source, Tectonophysics

Dr. Ya-Ju Hsu
Ph.D., National Central University
Crustal deformation

Dr. Shiann-Jong Lee
Ph.D., National Central University
Seismology

Dr. Chung-Ho Wang
Ph.D., University of Hawaii
Isotope Geochemistry, Isotope Hydrology

Dr. Kuo-Lung Wang
Ph.D., National Taiwan University
Isotope geochemistry Igneous petrology, Petrology

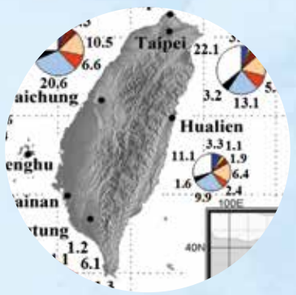
Dr. Kuo-Fang Huang
Ph.D., National Cheng Kung University
Isotope geochemistry Paleoceanography, Paleoclimatology, Marine Chemistry

Dr. Der-Chuen Lee
Ph.D., University of Michigan
Isotope geochemistry

Dr. Wen-Pin Hsieh
Ph.D, University of Illinois, Urbana-Champaign, IL
Experimental high pressure physics, Geophysics, Ultrafast optics

Dr. Frederic Deschamps
Ph.D., Universities of Paris XI & Nantes
Geophysics

Dr. Eh Tan
Ph.D., Seismological Laboratory, California Institute of Technology
Geodynamics, Geophysics, Parallel supercomputing



Dr. Kwan-Nang Pang
Ph.D. University of Hong Kong
Isotope geochemistry

Dr. Hsin-Hua Huang
Ph.D., National Taiwan University
Seismology, Seismotectonics

National Central University College of Earth Sciences Department of Earth Sciences

Dr. Chien-Ying Wang
Ph.D., Saint Louis University
Seismology, Seismic Prospecting, Seismic Wave Propagation

Dr. Kuo-Liang Wen
Ph.D., National Central University
Earthquake Engineering, Strong Motion Seismology, Site Effect Analysis

Dr. Shu-Kun Hsu
Ph.D., Université de Bretagne Occidentale
Marine geophysics, Gravity and magnetics, Tectonics

Dr. Andrew Tien-Shun Lin
Ph.D., Oxford University
Geodynamics, Petroleum Geology, Sedimentary Geology

Dr. Po-Fei Chen
Ph.D., Northwestern University
Seismology, Geophysics

Dr. Konstantinos I. Konstantinou
Ph.D., University of Durham
Volcanic Seismology, Tectonophysics, Time series analysis

Dr. Li-Wei Kuo
Ph.D., National Taiwan University
Clay mineralogy, Experimental rock deformation, and tectonophysics

Dr. Hoa Kuo-Chen
Ph.D., State University of New York at Binghamton
Geophysics, Seismology, Seismotectonics, and Geodynamics

Graduate Institute of Applied Geology

Dr. Jia-Jyun Dong
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Geotechnical Engineering, Rock Mechanics, Engineering Geology, Landslide and Barrier Lake

Dr. Chuen-Fa Ni
Ph.D., Michigan State University
Groundwater Modeling, Stochastic Hydrogeology, Groundwater Inverse Problems, Applied Geostatistics, Development of Software Environment for Engineering Education

Dr. Chyi-Tyi Lee
Ph.D., National Taiwan University
Engineering geology, Geostatistics, and GIS

Department of Atmospheric Sciences

Dr. Ming-Cheng Yen
Ph.D. Iowa State University
Monsoon meteorology, Climatology

Dr. Jough-Tai Wang
Ph.D., Oregon State University
Climate dynamics, Numerical weather prediction

Dr. Jia-Yuh Yu
Ph.D., University of California, Los Angeles
Tropical Climate Dynamics, Air-Sea Interactions

Dr. Kuo-Ying Wang
Ph.D., Cambridge University
Atmospheric chemistry , Environmental pollution

Dr. Pay-Liam Lin
Ph.D., National Central University
Boundary layer meteorology, Mesoscale meteorology

Dr. Chian-Yi Liu
Ph.D., University of Wisconsin
Satellite Remote Sensing, Satellite Data Assimiliation

Dr. Kao-Shen Chung
Ph.D. McGill University
Radar meteorology, Short-term forecast errors, Mesoscale / Convective scale data assimilation

Graduate Institute of Hydrological and Oceanic Sciences

Dr. Tso-Ren Wu
Ph.D., Cornell University
Tsunami Science, Local Scour Simulation, Storm Surge Simulation, 3D Numerical Modeling; Two-way Coupled Moving-Solid Model, Landslide and Debris Flow Simulation

Dr. Ming-Hsu Li
Ph.D., Pennsylvania State University
Land Hydrological Processes, Hydrogeochemical Models, Hydro-hazard Simulations, Climate Change Hydrology

Dr. Hwa Chien
Ph.D., National Cheng Kung University
HF Radar and Microwave Radar Remote Sensing, Ocean Surface Waves, Air-Sea Interactions, Sediment Transport in Coastal Ocean

Graduate Institute of Space Science

Dr. Yen-Hsyang Chu
Ph.D., National Central University
Radar Remote Sensing of Atmosphere, Ionospheric Physics

Dr. Yuei-An Liou
Ph.D., University of Michigan
Microwave and Optical Remote Sensing; Atmospheric Science; Electromagnetics; GPS Meteorology and Methodology; Cryosphere (permafrost, glaciers)

Dr. Loren Chee-Wei Chang
Ph.D., University of Colorado
Atmospheric Tides, Planetary Waves, Mesosphere, Lower Thermosphere, Atmosphere -Ionosphere Coupling, Satellite Data Analysis, Satellite Remote Sensing

Research Topics

There are three strands of research in this graduate program.

1. Aquatic Sciences

The primary research emphasis in the aquatic sciences is on the global biogeochemical cycle: processes that affect the sources, transport, transformation and fate in the cycling of material among the hydrosphere, atmosphere, lithosphere and biosphere. Present research activities focus on the role of the ocean and the impacts of human activities on this cycle. Some specific examples are: the contribution of the marine carbon cycle to the global carbon cycle and its behavior under rising tmospheric CO2, coupling of atmospheric processes to the biogeochemistry of the oceans, the role of fluvial inputs to the marine biogeochemical cycle, marine nutrient dynamics and its relationship to the marine carbon cycle, the role of microbial activities in the marine biogeochemical cycle and the effect of trace metal availability and speciation on photosynthetic activities in the ocean.

2. Atmospheric Sciences

(1) Atmospheric Chemistry

This subject currently focuses on studies of middle atmospheric chemistry (centered on ozone chemistry) and tropospheric chemistry (pollution chemistry). Remotely sensed observations are used to study the chemistry of species such as ozone, water, nitrous oxide, carbon monoxide, and methane. Global and regional models are used to interpret the observations. In-situ measurements in polluted cities are made for monitoring the sources and sinks of toxic compounds such as ozone which can cause serious human health effects. Heterogeneous chemistry and aerosol production pathways are parts of the program. Research programs on the physicochemical properties of atmospheric aerosols and their implications on regional climate changes, and the exposure and risk assessments of toxic compounds on public health and ecosystems are under active development.

(2) Atmospheric Dynamics

This topic currently focuses on the climate and meteorological system of the earth. Global andregional models are used to simulate the cycling of water and other material through the atmosphere. Climate variability and climate change, including monsoon dynamics, air-sea interaction, tropical meteorology, cloud-radiation and global warming, are central components of the global modeling. The regional studies place a primary focus on the dynamical processes in East Asia. The research on the hydrological cycle attempts to gain insight into processes that control the rate of precipitation. The distributions of atmospheric chemicals are used to constrain the dynamical processes in the upper troposphere, stratosphere, and mesosphere, including stratosphere-troposphere and mesosphere-stratosphere exchange processes. Paleo-climate and future climates are also a focus of the program.

3. Solid Earth Sciences

The interior of the earth is a mixture of rocks and fluid that are constantly churning, transforming, and breaking. To understand these processes, a variety of geophysical approaches can be used. Today seismology has enabled us to see almost every corner of the earth, while potential methods such as gravity and magnetic analyses sample the earth's strata as a whole. On the one hand, earthquakes serve as a powerful tool, for probing the inner-working of the Earth. On the other hand, understanding them so as to mitigate their hazards has become as essential task in a modern society. The program in the Solid Earth Sciences is focused on using and advancing geophysical methods to explore the structure and evolution of our dynamic planet, and to integrate and apply the knowledge on the Earth system for its sustainable development in order to satisfy societal needs.

Course Offerings

Four types of courses are being offered:

(1). Required courses
(2). Core courses in each research strand
(3). Elective courses
(4). Elementary Chinese

A. Introductory Earth System Science(3 credit units)
B. Seminar and Research Discussion (1 credit unit)
Core courses: (3 credit units each)

A. Aquatic Sciences
I. Marine Biogeochemistry
II. Physical Oceanography
III. Marine Ecology

B. Atmospheric Sciences
I. Atmospheric Chemistry
II. Atmospheric Dynamics
III. Aerosols and Air Pollution

C. Solid Earth Sciences
I. Global Seismology
II. Geology and Tectonics
IIII. General Geophysics

3. Elective course (3 credit units each):

A. Methods for Atmospheric Monitoring
B. Space Weather
C. Atmospheric Chemical Models
D. Health Risk Assessment for Environmental Pollution Issues
E. Introduction to Planetary Atmospheres and Astrobiology
F. Marine Biogeochemical Cycle
G. Marine Organic Chemistry
H. Aquatic Chemistry
I. Isotopic Geochemistry
J. Marine Biogeochemistry Laboratory
K. Marine Biogeochemical Models
L. Computational Seismology (2 credit units)
M. Strong Motion Seismology (2 credit units)
O. Observational Seismology (2 credit units)
P. Tectonic Geomorphology (2 credit units)
Q. Crustal Deformation (2 credit units)
R. Geophysical Inverse (2 credit units)
S. Earthquake Source Mechanism (2 credit units)
T. Seismic Exploration (2 credit units)
U. Special Course on Seismic Studies on Atmospheric, Hydrospheric, and Lithospheric Processes (2 credit units)
V. Discussions On Con t empor ar y Issues: Aqua tic Photochemistry (2 credit units)
Directed readings in oceanography (1 credit unit)
W. Discussion of Marine Trace metal biogeochemistry (2 credit units)
X. Mesoscale meteorological modeling and analysis
Y. Discussions on Contemporar y Issues: Broadband Seismic observation

More courses:

http://www.rcec.sinica.edu.tw/tigp-ess/schedule.html

4. Other required course:

1-yr Elementary Chinese (required for overseas students only)

Curriculum Philosophy Highlights

The program aims to develop confident researchers who are self-reliant and capable of working in a team and independently.

- Entering students without an identified thesis advisor are invited to rotate through the mentorship of several faculty members until an advisor can be identified. This process should take place preferably within the first two semesters of the enrollment of a student in the program.
- Whenever pedagogically advantageous, the program adopts a team-teaching system, whereby each faculty member teaches the subsection in a course in his or her area of primary expertise.
- In keeping up with the international stature of the program, all courses will be offered in English.

Requirements for the Ph.D. Degree

1. Course Work

Credit requirement

The overall course requirements for the Ph.D. in all research strands are similar. Students, who enter the program with an earned Master's degree, must complete a minimum of 18 credit units of course work, excluding seminars and research. Students, who enter the program without an earned Master's degree must complete a minimum of 34 credit units of course work, excluding seminars and research. All international students are also required to take one year of Elementary Chinese, but credit units in these courses cannot be used to satisfy the overall credit requirement.

Course distribution

A student must declare a research strand among the three offered in this program upon admission into the program. The typical course distribution is as follows:

(1) Required course for all students-Introductory Earth System Science.
(2) Core courses in declared research strand - 2 courses out of the list of 3 courses in the student's declared research strand.
(3) Elective courses - any number of the remaining courses offered by the ESS program as approved by the thesis advisor.
(4) Seminar and Research discussion – to be taken for at least four times. It is the responsibility of the advisor to assist each student in formulating a program of study that will best satisfy his or her personal needs and fulfill the graduation requirements. Depending on the background of the incoming student, a prescribed program of additional courses for making up background deficiencies might be required as part of the degree requirements.

Time schedule

Students are expected to complete at least 6 courses (at least 18 credit units) within the first two years of enrollment. Students are also required to take a one-credit course on "Seminar and Research Discussion" in each semester, for a total of four credit hours, during the initial two years of their enrollment in the program.

2. Research skill requirement

Students who have declared the Aquatic Sciences as their research strand are required to have at least 5 days of cumulative sea-going experience on research vessels.

3. Selection of Thesis Advisor

Incoming students are expected to identify a thesis advisor by the end of the first six months, and in no case later than the end of the first year, of study in the program. Every incoming student is expected to become familiar with the research work of a number of laboratories before proposing a specific faculty member as the prospective thesis advisor. The process might involve attending a series of seminars on faculty research in the program, or a series of laboratory rotations. The formal assignment of an identified faculty member as a thesis advisor requires the agreement of the faculty member to serve in such a capacity and the final approval by the Student Affairs Committee.

4. Thesis advisory committee

A thesis advisory committee, composed of three(3) to five(5) members with ranks of assistant fellow/professor and above, shall be formed by the thesis advisor with input from the student to guide the student and evaluate his/her doctoral dissertation research. The composition of the thesis advisory committee must be approved by the Student Affairs Committee.

5. Study plan

A student must submit a study plan before the end of the first year. A study plan must include a course plan, a dissertation research theme, a proposed timeline of events toward the degree. The study plan must be approved by the thesis advisory committee. Before the study plan is approved, a student can not apply to take the Qualifying Exam. The annual progress report shall be made out by the thesis advisor and the thesis advisory committee. The report shall be sent to ESS office before Aug. 20th of every year.(The TIGP stipend will be renewed annually another two years upon evidence of satisfactory progress towards the degree.)

6. Qualifying Examination

Students are required to have successfully completed the qualifying examination and advanced to candidacy for the Ph.D. degree by the end of the third year of study in the program.

A.Written exam

After completing at least one academic year of work in the program, a student may apply to the curriculum committee to take the written section of the qualifying examination with the approval of his or her thesis advisor. A student has only two chances to pass this section of the qualifying examination. If a student fails the written section for the first time, s/he may apply to the curriculum committee for re-taking it as early as the next time when it is offered. Students who fail the written section of the qualifying examination twice will be dismissed from the ESS Program. The scope, questions, and grades of written exam will be determined by the thesis advisory committee, based on the student's courses taken and research interest.

B.Oral exam

After passing the written section of the qualifying examination, a student should submit a research proposal to the curriculum committee for evaluation within 1 year. The oral section of the qualifying examination is based predominantly on this research proposal. An examining committee, consisting of at least five faculty members, will be appointed by the curriculum committee. During the oral section of the qualifying examination, the student should be prepared to present to and discuss with the members of the examining committee the justifications and plans for his or her thesis work, including relevant literature, and his or her progress on the thesis work to date. A student has only two chances to pass this section of the qualifying examination. If a student fails this section for the first time, s/he may apply to the curriculum committee for re-taking it as early as the next time when it is offered. Students who fail the oral section of the qualifying examination twice will be dismissed from the ESS Program.

7. Advancement to Candidacy

A student who has passes both the oral and the written section of the qualifying exam advances to candidacy. He or she will devote full time to independent study and research on his or her thesis topic.

8. Publication

A Ph.D. candidate must have at least one manuscript published or accepted for publication as the first author in a SCI (Scientific Citation Index) listed journal, before s/he can apply to the faculty committee to take the oral defense of his/her thesis work before the members of an examination committee.

9. Thesis Defense

This defense will take the form of a thesis seminar followed by an oral examination on the thesis research. The examination committee is appointed by the curriculum committee and is consisted of at least five faculty members whose expertise is closely linked to the candidate's area of the examination committee.

Admission to the Ph.D. Program

The Program offers admissions for the fall semester only. The deadline for application is March 31 every year. It is to the advantage of the students to apply as early as possible. For more information regarding admission to the Ph.D. program, please visit TIGP website (http://tigp.sinica.edu.tw).

Students with a B.S. or M.S. degree from an accredited institution will be considered for admission. The following criteria/materials will be used to evaluate the applicant's qualifications for admission:

1. Undergraduate and graduate academic records or transcripts.
2. The General Test of the Graduate Record Examination (GRE): General and Subject scores are optional but applicants are strongly encouraged to provide it. Applicants, who fail to submit GRE scores for evaluation, should provide supplementary information (e.g. M.S. thesis, research publication, description of research experiences, etc) that can demonstrate potential in research.
3. English proficiency: All applicants whose first language is not English must submit the English test score, except those applicants who have recently completed two or more years of study in an English-speaking country.

(1). **TOEFL :** scores of 550 on the paper based (or 79 on the New Internet-based TOEFL (TOEFL-iBT)) or higher; (Our institution CODE & NAME are: 7142 Academia Sinica) Only ETS International TOEFL will be accepted. Institutional TOEFL will not be accepted.

(2). **GEPT :** Instead of TOEFL, applicants in Taiwan may take the General English Proficiency Test (GEPT) administered by the Language Training and Testing Center. Applicants are required to submit their high-intermediate level certificate when applying for admissions;

(3). **IELTS** (International English Language Test System): Scores of 5.5 or higher on the Academic Test is required.

4. Three letters of recommendation commenting on the applicant's personal character, and qualifications for independent study, including intellectual ability, research
5. Statement of purpose (Plan and reason for graduate study) Application can be submitted through the on-line application system http://db1x.sinica.edu.tw/tigp/ (recommended) or by post. The submitted application materials will not be returned to applicants under any circumstances. The complete application materials should be received by TIGP before March 31.

Student Status and Degree Conferral Policy

Degree candidates in the ESS program must be officially registered students of the College of Earth Sciences of the National Central University. Students who enter the ESS program with a B.S. degree will enroll first as a pre-Ph. D. student till they are approved to enroll in the Ph. D. program. Upon graduation, a student will be conferred a Ph. D. degree and will receive a diploma from the National Central University as well as a certificate from the Academia Sinica.

Cost of Study

The payment of tuition fees (basic fees NT$16,200/US$506 + credit fees NT$15,700/US$490 per semester) for international students should be made on Student Registration Day.

Fellowship Support and Stipends

The TIGP will provide full fellowship for all incoming graduate students during the first year of their enrollment at about NT$34,000 (about US$1,060) per month. The support will be extended for another two years upon evidence of satisfactory progress towards the degree. In subsequent years, the financial support will be provided by the student's thesis advisor(s). The amount of the support will be at the discretion of the advisor.

Medical Insurance

Six months after the student receives the Alien Resident Certificate (ARC), the student will be qualified for Taiwan's National Health Insurance Program. The students are expected to pay the same premium as all the Taiwan citizens and will be entitled to the same medical coverage.

Living and Housing Costs

Options include on-campus housing and off-campus housing. On-campus self-catering student dormitory providing single study bedrooms is available to TIGP students at reasonable costs (for details please visit our website at http://tigp.sinica.edu.tw/Accommodation.html).

Off-campus private housing is generally more expensive. Rents for off-campus apartments range from NT$5,000-15,000 per month.Meals are available at modest costs at various eateries within the campus of the Academia Sinica. The Sport Center on campus, which is equipped with indoor jogging track, gym, swimming pool, aerobic court, and so on, is also available to students at modest costs.

Correspondence and Information

For information concerning this program, please contact:

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