

# **Grand Challenge Scholars Program**

**APPLICATION TO THE NAE**

**GRAND CHALLENGES SCHOLARS PROGRAM (GCSP)**

**BY**

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## **1. Vision and Goals**

The College of Electrical and Computer Engineering (ECE) at National Chiao Tung University, Taiwan is pleased to submit this proposal to establish a National Academy of Engineering (NAE) Grand Challenge Scholars Program (GCSP).

Located next to Hsinchu Science Park, Taiwan's Silicon Valley, the College of Electrical and Computer Engineering, National Chiao-Tung University (NCTU) is the alma mata of its many company founders and employees. We not only include the best departments and institutes in the EE field in Taiwan but also have close ties with National Chip Implementation Center, a state-of-art research facility in IC design and fabrication, and two world renowned chip foundries, Taiwan Semiconductor Manufacturing Company (TSMC) and United Microelectronics Corporation (UMC). ECE College offers top-notch education in Electrical and Computer Engineering and promises excellent employment opportunities in Taiwan's information technology industry.

However, it is estimated by the U.S. Department of Labor that 65% of school-aged children will work in careers that do not exist today. The curriculum being taught in many schools is unfortunately not aligned with the skills needed in an increasingly digital economy. We want to ensure that future generations remain competitive in the global economy, and today far too many graduates enter the workforce without sufficient exposure to enough skills that help foster innovation and creativity. Will our students be

innovators, or followers? Strong, resilient problem solvers, or servants of the status quo? The answer has everything to do with education. ECE College, NCTU's mission is to educate students in the ECE field so that they are well equipped with the knowledge and ability to succeed in today's global market. Combined with the Grand Challenge Scholarship Program, ECE College, NCTU will be able to educate our students to become future leaders by providing pragmatic solutions for basic human needs, bridging technologies to sustainable society, and reinventing human and machine interactions.

## 2. Program Components

### 2.1 Overview

The Grand Challenges Scholars Program in NCTU has three components required to satisfy the expectations of students enrolled in the GCSP. The three components are the preliminary courses, the core courses, and the advanced courses. The details of these three components are described in Figure 1 and the next sections.

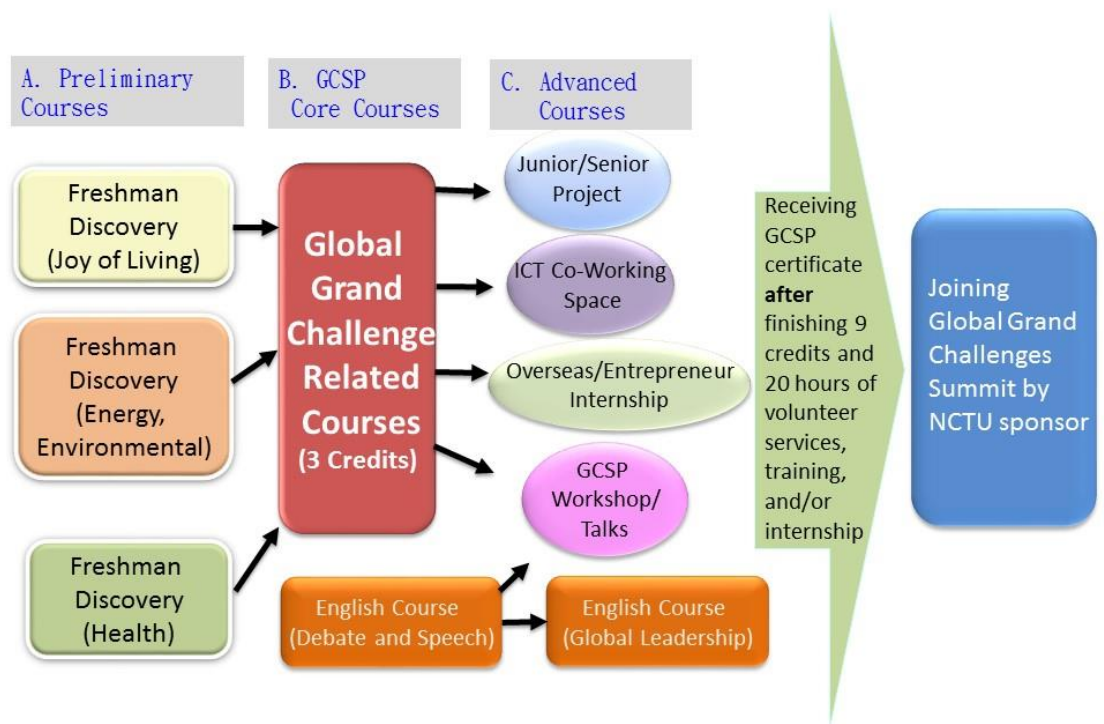


Figure 1: Grand Challenge Scholars Program in NCTU

### 2.2 Components for Grand Challenge Scholars Program

We intend to implement the GCSP in three different stages:

**1. Preliminary Courses:** A series of “Freshman Discovery” courses are implemented in our ECE College. The grand challenges identified by NAE will be launched in this series of courses, including energy and environment,

health, security and society, and joy of life. Students will be encouraged to conduct technology survey, discussion, and debate, to identify grand challenges in one of the challenging domains. In Appendix A, we provide a list of “Freshman Discovery” courses and their corresponding course objectives.

**2. GCSP Core Course:** A three credit course will be offered in ECE College as the GCSP core courses. Several focused topics or projects will be conveyed in this course to provide deeper insights and practical solutions for students. For example, one of our courses, Creative Software Project, is a course aiming at developing software projects usable in real-world. This course focuses on “learning by doing”, ”team work”, and “research/startup-oriented”. It covers fundamental and advanced development tools (git, ROS, OpenCV) in C++ or Python through “Duckietown”, an open course “MIT 2.166 Autonomous Vehicles.” Students are encouraged to form their own teams and propose software projects. Students will have great chances to engage in application-oriented projects in autonomous vehicles and robots. How engineering problems and solutions affects our human lives will be investigated in this course. The Steering Committee at NCTU has the rights to determine which feasible courses belong to the category of GCSP Core Courses.

### **3. Advanced Courses and Trainings:**

- (1) **English Courses:** To enhance the capability of global participation for the students, two English course will be specially designed and offered to our GCSP students including “Debate and Speech” and “Global

Leadership”. These two courses aim at providing extensive in-class discussions and presentations. Students will be able to strengthen their English presentation and debating skills, as well as to cultivate their potential leadership.

- (2) **Innovative Creative Technology (ICT) Co-Working Space:** Students are encouraged to take courses/micro-courses in the ICT co-working space, which is initiated by NCTU to promote students’ multi-discipline capabilities. There are fourteen different categories of ICT courses, including IoT, robotics, drone, embedded system, virtual reality and augmented reality, bio-electronics, sensor components, wireless communications, and etc.. For example, one of the courses listed in the IoT category of ICT Co-Working Space is the “Introduction to IoT and Cloud Service: Internet Device”. This micro-course introduces the history, definitions, structure and application of IoT. Students taking this course will have the chance to conduct implementation project on monitoring services for air quality.
- (3) **Junior/Senior Project:** GCSP students at NCTU will be provided with the opportunities to conduct junior/senior project with faculty who are involved in problem-solving for GCSP. The length of project may go from one semester to two semesters depending on the requirement of participated faculty. The research fields of projects may cover various domains including electrical engineering, computer engineering, bio-engineering, and generic engineering problems.

(4) **Entrepreneur Internship and Volunteer Services:** Students will be offered with various opportunities to participate international and local entrepreneur internships and volunteer services. For example, students are encouraged to apply for the following three programs offered by our NCTU GCSP, including Student Exchange Program, Summer Research Internship Program (SRIP), International Entrepreneurship Program (IEP), and International and Local Volunteer Services.

(a) **Student Exchange Program:** The College of ECE at NCTU offers student exchange program with several top-notch schools all around the world (as shown in Appendix B), such as University of Illinois at Urbana-Champaign (UIUC), Carnegie Mellon University (CMU), and K.U. Leuven. Selected students in our NCTU GCSP will have higher priority to get accepted and granted with scholarship while applying for the exchange program.

(b) **Summer Research Internship Program (SRIP):** The College of ECE currently is actively signing Summer Research Internship Program with many prestigious universities, including UCLA, USC, and UC Davis. Selected students from GCSP will have the opportunities going abroad to be summer interns in these elite schools. They will have two months to conduct research projects in selected faculty's laboratories. We expect to bring out more high-quality research achievements of bilateral international cooperation and cultivate promising leaders through this program.

(c) **International Entrepreneurship Program (IEP):** Nowadays, innovative entrepreneurship has been a new trend for students all over the world. The College of ECE has signed the international



program of innovative entrepreneurship with Princeton University. We will take this contract as a model and expand to other top schools, such as Stanford university, Singapore University of Technology and Design, and University of Hong Kong. Selected GCSP students will spend summer time in one of these universities to attend bi-directional entrepreneurship workshop, visit and engage with international companies, and conduct business-oriented projects and discussions.

**(d) International and Local Volunteer Services:** In order to engaging NCTU GCSP students with human care, numerous activities will be hosted in NCTU to provide international and local volunteer services. Students participate in this service will be able to provide their help physically and mentally to others who need assistance. For example, students spent their summer time building a wooden structured library for local children in the mountain county of Taiwan, Tai-Dong, and teaching and helping these children to learn computer skills just like modern children.

**(5) GCSP Workshops and Seminars:** The GCSP at NCTU will inspire students by hosting various workshops and seminars with speakers on global leadership, innovation, and human care. Students will have the chance to meet top industrial leaders, educators, and philosophers to gain insight into their successful stories.

The basic requirement for each student to acquire GCSP certification at NCTU is to achieve 9 credit hours of GCSP curriculum courses and 20 hours

of volunteer services, training, and/or internships. With progressive participation of GCSP at NCTU, students should be able to obtain the GCSP certification in their junior or senior year. The GCSP-certified students will be encouraged and sponsored by NCTU to attend the annual Global Grand Challenges Summit (GGCS) hosted by NAE GCSP in the United States.

### **3. Program Recruitment and Mentoring**

#### **3.1 Recruiting Students**

We will work with admission offices and coordinators across all departments at NCTU to disseminate information about the NCTU GCSP, and draw students in as participants. In particular, promotion to prospective students will come in the form of web presence, printed posters, and electronic mailings sent to prospective and admitted students, and presentations given at recruiting events. We will also promote through first-year orientation events, on-campus messaging, club and organization fairs, and academic advising sessions that take place throughout the year.

#### **3.2 Application and Selection**

Students interested in participating in the NCTU GCSP will apply to enter the program as early as the first semester of their freshman year, but no later than their third year as junior. Approximately 20 student candidates will be selected annually based on a completed application and interview process. A GCSP Candidate must meet the following requirements to be admitted to the NCTU GCSP:

1. Interested students will submit a proposal package including the following documents:
  - (1) An application form including basic information
  - (2) A resume to identify studying objective, education, work experiences, and current/past service activities.
  - (3) A one-page statement of purpose (SOP) to describe their interests in the Grand Challenge Scholarship Program.

- (4) Their academic plan showing proposed course selection and how they will complete the required components of the GCSP program.
  - (5) An official transcript showing all completed coursework.
2. We will review each GCSP applicant proposal package and identify a total of approximately 20 GCSP candidates each year.
3. The GCSP Candidates must remain in good standing with a minimum 2.7 GPA at the time of application and maintain this 2.7 GPA at all times while considered a GCSP Candidate.
4. GCSP Candidates will be associated with GCSP Mentors who are able to work with them to meet the GCSP requirements.
5. Selected GCSP Candidates will be eligible to receive travel support to present their grand challenge research or design project at the annual Global Grand Challenges Summit (GGCS).

## **4. Program Administration**

### **4.1 Steering Committee and Faculty Mentorship**

Faculty will have direct oversight of the curriculum, advising, and overall evolution of the GCSP at ECE College, NCTU. A faculty director will be appointed from the Dean of the ECE College, NCTU. Along with the director, a Steering Committee will be formed. The Steering Committee will consist of chairmen from each department. Initial terms will be 2 or 3 years, then shift to 3-year staggered terms after the first 2-years the program is in place. The role of the Steering Committee consists of the following responsibilities:

1. Review student applications to GCSP and assess applications for program entry.
2. Oversee curricular development and work with faculty advisors on student progress.
3. Identify and characterize the feasibility of new, co-curricular and extra-curricular activities and experiential learning opportunities that support GCSP objectives.
4. Review and approve changes to the structure of the GCSP program.

Ultimately, the Steering Committee is the body that reviews an application and grants “Grand Challenge Scholar” status on a student and “certifies” that the student has met all requirements of the GCSP. That certification would be facilitated by input from the faculty mentor/advisor, who would assess whether required courses and activities are met.

### **4.2 Funding and Support**

The sustainability of this program is an important consideration for us. We are

realistic that these programs cannot succeed without sustained commitments and resources by university administration. We expect to support NT\$3,600,000 which is roughly US\$120,000 for the initial three years.

Table 1. Costs in Taiwanese Dollar for GCSP at NCTU for the initial three years of the program.

In Taiwanese Dollar

<b>Fixed/Variable Costs</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>
<b>Marketing/Promotion</b>	400,000	200,000	150,000
<b>Course related</b>		200,000	100,000
<b>Travel, stipend, and etc.</b>		200,000	800,000
<b>Staff</b>	300,000	600,000	600,000
<b>Total</b>	700,000	1,200,000	1,700,000

## **5. Conclusion**

The overall objective of the Grand Challenge Scholars Program is to prepare the next generation of students for addressing the grand challenges facing society in this century. We combine curricular, co-curricular, and extra-curricular program with five GCSP competencies: (1) Research related to a Grand Challenge; (2) Interdisciplinary Component; (3) Entrepreneurship; (4) Global Dimension; (5) Service Learning. We expect our GCSP-certified students at NCTU to possess independent thinking, innovation, globalization, entrepreneurship, especially humanistic solicitude.

## **Appendix A – Example for Preliminary Courses**

### **Freshman Discovery**

#### **Course Number: DCE1105**

##### **1. Intelligent Electronics: A World of Intelligence**

With the development of the industry of intellectual electronic, we are facing a world full of intelligence as claimed by Kevin Kelly, the frontier of Internet culture. At the same time, the human society is much similar of a social nervous system. The course leads discussion of the following topics:

1. How do people identify themselves in such era?
2. What is the future development the industry structure?
3. What is the future development of the social nervous system?

In order to provide students with experiences on the combination of hardware and software, which is the required ability of programmers, this course also arrange experiments with the sensor operations and IoT applications.

##### **2. Exploration of Global Engineering Related Issues: Virtual Reality and Artificial Intelligence**

The development of virtual reality (VR), augmented reality (AR), artificial intelligence (AI), and machine learning (ML) is leading human to the dawn of a new era. These new technologies are categorized in the “Joy of Life” enhancement of the NAE GCSP. Meanwhile, ECE college of NCTU is the first institute in Asia to join the GCSP. In this course, fundamental concepts and application scenarios of these technologies will be introduced. Group discussions are encouraged in class to increase interactions and class participation of students. Each



student is required to provide two English presentations on these topics based on a problem-solving manner. Students are also encouraged to apply their new insights to international engineering issues and become a potential leader of engineering with global vision.

### **3. The Role of Electrical Engineer in the Field of Energy and Disease Analysis**

This course leads discussions on the issues faced by human being from the aspect of energy and biomedical analysis, which fall in the health and energy categories of NAE GCSP. In this course, aside from the knowledge from the field of electrical and computer engineering, students are encouraged to be well-trained and build interdisciplinary vision, knowledge and ability.

## Appendix B – List for our Sister Universities

Area	Schools
<b>America</b>	University of Illinois at Urbana-Champaign
	Carnegie Mellon University
	University of Washington-Seattle
<b>Europe</b>	Katholieke Universiteit
	University of Antwerp
	Université libre de Bruxelles
	Chalmers University of Technology
	Technische University Munchen
	University of Stuttgart
	Reutlingen University
	University of Mannheim
	Leibniz Universitat Hannover
	RWTH Aachen University
	Université Paris-Sud
	Ecole Supérieure d' Electricite
	Telecom and Management Sudparis
	Jean Moulin University Lyon 3
	Institut Supérieur d' Electronique de Paris (ISEP)
	Linköping University
	KTH Royal Institute of Technology
	University of Twente
	Technical University of Denmark (DTU)
	University of Jyväskylä
	KOC University
	University of Southampton
Swiss Federal Institute of Technology Zurich	
Graz University of Technology	
Korea University	
<b>Asia</b>	The University of ElectroCommunications
	NAIST
	Nagoya University

The University of Tokyo
Osaka University
Nanyang Technological University
Seoul National University
Shanghai Jiaotong University
Peking University
Tsinghua University
Beijing Jiaotong University
Zhejiang University
University of Hong Kong
Ewha Womans University