

# Grand Challenge Scholars Program Proposal

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## **The University of Toledo Grand Challenge Scholars Program**

### **1.0 Summary:**

“A global human society based on poverty for many and prosperity for a few, characterized by islands of wealth, surrounded by a sea of poverty, is unsustainable,” South African President Thabo Mbeki told delegates at the opening session of the World Summit on Sustainable Development recently held in Johannesburg. “The tragic result of this is the avoidable increase in human misery and ecological degradation, including the growth of the gap between North and South.” It is the new global concern for sustainability, and in particular the environmental impacts of sustainable development, that underpins the need for multidisciplinary education of our technically trained students to appreciate the societal and social responsibilities of engineers and scientists.

The University of Toledo (UT) College of Engineering is proud to submit a proposal for a Grand Challenge Scholars Program (GCSP). The UT College of Engineering is a nationally ranked college known for its 85 year tradition of educating students to become engineers while advancing engineering knowledge. It has a strong record of excellence in providing students with career pathways. Our high-quality student body, comprehensive selection of professional programs and focus on experiential learning (both curricular and extracurricular) are well-suited to achieve the goals of a program that incorporates hands-on learning, multidisciplinary curriculum, entrepreneurship, a global perspective and service learning.

Student members of our Roy and Marcia Armes Engineering Leadership Institute (ELI) have participated in the 2013 and 2015 Global Grand Challenges Summits and have taken the lead in developing this proposal. ELI was founded to provide a select group of UT Engineering students with opportunities to develop leadership skills and to use these skills to assume leadership positions in the engineering profession. This GCSP proposal serves to broaden the reach and to formalize this leadership training into our curriculum. It is our intent that this program will provide opportunities for UT engineering students to take leadership in solving the grand challenges that face our nation and our world.

Our proposed GCSP will afford students with a cutting-edge education within the disciplines associated with the 14 Grand Challenges (GCs). Our GCSP will provide a sequence of coursework and experiences that will fit into any of our ABET-accredited degree programs with our existing mandatory three-semester co-op experience and with our existing minor in Entrepreneurship from the UT College of Business and Innovation. The proposed program will function as a multidisciplinary program that draws upon expertise available across multiple colleges. It is essential that the GCSP has a connection to practical experience in order that graduates have the capacity to excel in meeting the challenges of today as well as those of the future. Graduates of this program will be well-prepared to deal with the GCs that we currently face, in addition to new GCs that may arise in the future.



## **2.0 Mission and Vision:**

The mission of the UT College of Engineering is to achieve prominence as a student-focused college that educates engineers of recognized quality to be leaders in engineering disciplines, technology and society; and as a college that enhances the well-being of the region, state and nation through the creation and transfer of new knowledge.

The mission of the University of Toledo is to improve the human condition; to advance knowledge through excellence in learning, discovery and engagement; and to serve as a diverse, student-centered public metropolitan research university. In our unique role as the comprehensive engineering school in Northwest Ohio, the UT College of Engineering provides outstanding undergraduate and graduate programs to educate the leaders of tomorrow. We are committed to leadership in the creation and transfer of new knowledge and technologies through the efforts of a diverse faculty, staff and student body.

Our vision is to achieve national prominence by providing a diverse, student-centered, stimulating learning environment that actively engages undergraduate and graduate students in engineering education and research while benefiting society through the creation of new knowledge and technologies. We are committed to being a source of outstanding engineering graduates, knowledge and expertise as we strive to serve our region, the State of Ohio, and beyond.

Thus, producing graduates that are prepared to address the NAE Grand Challenges for Engineering is well within our mission and vision. The UT College of Engineering has ongoing research and educational programs for economical solar energy, engineering better medicines, restoring and improving urban infrastructure, securing cyberspace, providing access to clean water and engineering tools of scientific discovery. Furthermore, our College has the infrastructure in place for the educational experience envisioned by the GCSP, including experiential and service learning, interdisciplinary curricula, entrepreneurship and a global focus.

Our proposed GCSP supports the mission of our University and of our College, meets the requirements for GCSP programs and produces graduates that are well-prepared to contribute to solutions for the 14 NAE Grand Challenges for Engineering. Graduates of this program will have the skills needed to influence both industrial and government policy decisions to produce a better society. The integrated nature of our society makes it increasingly difficult to evaluate the costs and benefits to a global society of corporate and government decision-making. In today's global society, we require graduates who are equipped to serve as a translator between industry, government, and non-governmental organizations that facilitate interactions that lead to sustainable systems. We believe that our graduates can become the next generation of leaders that will provide sustainable technological systems for the 21st century and provide a healthier planet for future generations.



### **3.0 Program Administration**

A GCSP Oversight Committee will consist of the GCSP program director, faculty representatives from various Engineering departments and current GCSP scholars. This committee will select students for admission to the program and supervise the progress of students toward program completion. During the Fall term, applications will be solicited from all first year students in the College of Engineering, and from all second year students with a 3.0 GPA. Applications will be solicited with email, letters to permanent addresses, and advertising on social media platforms. Applications will require a current résumé, a recommendation letter from a member of the UT faculty, a list of extracurricular activities at the high school and collegiate levels, and an essay to detail their interest in the GCSP. The selection criteria include a higher education GPA of 3.0 or greater, campus and community involvement and interest in the program. A maximum of 10 students will be admitted to the program each year.

The GCSP program will be advertised through numerous outlets. Recruiting staff from the College of Engineering will promote the GCSP during visits to local and regional high schools to engage prospective College of Engineering students. The GCSP will also be advertised to prospective students and their parents during campus tours and open house events. New students will again hear about this program through student organization presentations at new student orientation, new student convocation and during first year orientation courses.

Interested students can apply before or during the first semester of their second year and may be accepted to the GCSP latest by the end of the second semester of their second year. Although students beyond their second year might become interested in this program, the UT College of Engineering has a mandatory co-op program that begins toward the end of the student's second year. In order to utilize these mandatory co-op experiences to fulfill GCSP requirements, GCSP scholars must be admitted to the program prior to the selection of their co-op experiences during the second year.

To remain in the program, GCSP scholars must maintain a 3.0 higher education GPA and meet at least once every semester with the GCSP program director or designee to review their progress and curricular plan. GCSP scholars will also participate in a yearly GCSP Workshop to present and share information about their project experiences. During the semester before the completion of their degree program, each GCSP scholar must submit a report to the GCSP Oversight Committee verifying the completion of their GCSP program requirements along with their degree program requirements. GCSP scholars with identified deficiencies during this review will be given the opportunity to correct these deficiencies before completion of their degree program requirements. Students who successfully complete GCSP requirements will be recognized in the Engineering Honors Convocation during the semester in which they graduate.

Program outcomes will be assessed through feedback during and following completion of the GCSP program. Initial assessments will be performed by our ability to recruit high-quality students into the program. Subsequent feedback will be obtained through co-op employer surveys that are already completed as part of our mandatory co-op program and are used to assess learning outcomes for ABET accreditation. Ultimately, we will measure our success by



the success of our graduates in remaining involved in GC-related efforts post-graduation. We expect our graduates to find employment with government agencies, NGOs, public relation firms and think tanks, and corporations or engineering firms with missions that align with one or more GCs. We will also develop an advisory board, consisting of industrial, academic, and governmental members to provide regular feedback regarding our program and to make suggestions for improvements.



#### **4.0 Curriculum of Study:**

The University of Toledo College of Engineering has Bachelor of Science in Engineering Science degree programs in Bioengineering, Chemical Engineering, Civil Engineering, Computer Science and Engineering, Electrical Engineering, Environmental Engineering and Mechanical Engineering, and Bachelor of Science in Engineering Technology degree programs in Construction Engineering Technology, Computer Science and Engineering Technology, Electrical Engineering Technology, Information Technology and Mechanical Engineering Technology.

A GCSP curriculum has been developed that can be readily implemented into any of these four year undergraduate degree programs and will address the five curricular components mandated by the National Academy of Engineering (NAE): experiential learning, multidisciplinary curriculum, entrepreneurship, global learning and service learning.

#### **4.1 Experiential Learning:**

We propose to utilize our existing co-op program to allow students to obtain hands-on, experiential learning related to one or more the 14 GCs. A minimum of three semesters of co-op is required for our Engineering Science degree programs and is optional for our Engineering Technology degree programs. However, GCSP scholars in any of our five Engineering Technology degree programs will be required to participate in the co-op program.

These co-op experiences consist of full-time, 16 week work experiences in a Fall or Spring semester (640 hours total) or 12 week work experiences in a Summer semester (480 hours total). In preparation for their co-op experiences, all students enroll in a Professional Development course aligned with their major, and the-a full-time staff in our Engineering Career Development Center works with students to find co-op opportunities that meets the educational objectives of their degree program. To date, over 17,000 co-op placements with nearly 2,300 employers have been made during the nearly 20 years this program has been in place. Although a substantial majority of co-op rotations are completed in engineering industry, some students complete their co-op experiences in an academic research setting.

Students in the GCSP program will enroll in a GCSP-only section of their Professional Development course to prepare them for placement in a co-op experience that supports one or more of the 14 GCs. Engineering students must complete a minimum of three semesters on co-op; GCSP scholars will be required to complete one of these three co-ops through an experience that directly addresses one or more of the GCs. The GCSP director will coordinate with the Engineering Career Development Center to ensure placement in suitable industrial or academic research setting for this co-op experience. Upon completion of their co-op experience, GCSP scholars will present an overview of their co-op experience to the GCSP oversight committee and to other GCSP scholars. These presentations must address the relationship between the co-op experience and the GCs, how the work done on this co-op contributed to solving the particular issue, and what issues remain unresolved at this time.



Toward completion of their degree programs, GCSP scholars will also enroll in a GCSP-only section of their capstone design course to pursue a multidisciplinary, team-based capstone design project that addresses one of the 14 GCs. Projects will be selected in consultation with the GCSP oversight committee. Presentations of capstone projects will be made during our Fall or Spring senior design expositions that are open to the public.





#### **4.2 Multidisciplinary Curriculum:**

GCSP scholars will complete a suite of coursework outside of Engineering that is suitable preparation for their GC of interest. Engineering students must complete a University of Toledo core curriculum that includes two courses each in the humanities, social sciences and multicultural disciplines. In consultation with the GCSP oversight committee, GCSP scholars will select a series of core courses that serve as a foundation for students to pursue further study in one or more GC of interest.

Examples of relevant core courses include: AFST 4800 Social Change in Developing Nations; ANTH 2800 Cultural Anthropology; COMM 1010 Communication Principles and Practices; ECON 1010 Introduction to Economic Issues; ECON 3500 Comparative Economic Systems; FLAN 3440 Intercultural Communication; GLST 2000 Principles of Global Studies; IBUS 3150 Understanding Cultural Differences in Business; PHIL 2400 Contemporary Moral Problems; PSC 1400 Current Issues in U.S. Public Policy; PSC 1710 Current International Problems and SOC 1750 Social Problems.

#### **4.3 Entrepreneurship:**

Approximately 20% of Engineering students complete a Minor in Business while completing their Engineering degree program requirements. These minors include Business Administration and Professional Sales. The College of Business and Innovation also offers a Minor in Entrepreneurship, Family and Small Business (EFSB). All GCSP scholars will be required to complete the EFSB minor to satisfy program requirements.

Coursework for the EFSB minor includes ACTG 1040 Principles of Financial Accounting; EFSB 3480 Entrepreneurial Finance; EFSB 3500 Introduction to Entrepreneurship; EFSB 3590 Entrepreneurship & Small Business Management; EFSB 4010 Growing Family & Entrepreneurship Business; and EFSB 4690 Technology Commercialization.

In addition, GCSP applicants will be required to participate in our first year design and commercialization project. The College of Engineering houses the Nitschke Technology Commercialization Complex and the Thomas and Elizabeth Brady Engineering Innovation Center, which hosts the Angel Pitch 1.0 competition for first year students. This event features teams of first year Engineering students presenting their inventions and innovations in front of a panel of local business professionals.

#### **4.4 Global Experience:**

GCSP scholars will complete at least one core course with international topics as part of their core curriculum. As described in section 4.2 Multidisciplinary Curriculum, a variety of core courses have international content. Additional courses including language acquisition and skill courses, and Culture and Commerce courses are offered by the Department of Foreign Languages and satisfy core curriculum requirements.

GCSP scholars will also be required to complete an international travel experience approved by the GCSP oversight committee. The College of Engineering has an active chapter



of Engineers Without Borders that periodically travels abroad to engage in service learning opportunities. The University has other international service learning opportunities, such as Habitat for Humanity and Medical Mission trips, coordinated by our Center for International Studies and Programs (CISP). If availability permits, GCSP scholars will also be invited to participate in a Grand Challenge Summit hosted outside of North America.

#### **4.5 Service Learning:**

GCSP scholars will complete at least one core course with service themes as part of their core curriculum. As described in section 4.2 Multidisciplinary Curriculum, courses such as AFST 4800 Social Change in Developing Nations; PHIL 2400 Contemporary Moral Problems; PSC 1400 Current Issues in U.S. Public Policy; PSC 1710 Current International Problems and SOC 1750 Social Problems provide a curricular foundation for service learning.

GCSP scholars will also be required to complete both domestic and international service learning experiences approved by the GCSP oversight committee. In addition to an international service learning experience describe in section 4.4 Global Experience, GCSP scholars will also have to complete an approved service learning experience in the local Toledo community. A list of organizations that provide service learning opportunities is provided through the Office of Service Learning and Community Engagement within the Center for Experiential Learning and Career Services.



## **5.0 Budget and Resources:**

Existing resources will be utilized to ensure that all GCSP scholars will be able to complete curricular requirements outlined in the previous section, including the multicultural and entrepreneurship curricula described in sections 4.2 and 4.3 respectively. For experiential learning requirements in section 4.1, we have an Engineering Career Development Center in place with six full time placement staff and two administrative support personnel. This center is funded through a \$475 co-op fee assessed to each Engineering student upon enrollment in one of their three mandatory co-op experiences. The average co-op salary is approximately \$17 per hour, which results in an average gross co-op income for students of nearly \$11k during a 16 week Fall or Spring co-op, and over \$8k during a 12-week Summer co-op. To date, engineering students have been placed in over 17,000 co-op experiences in 45 states and 35 countries.

The Engineering Student Innovation Fund has been established to nurture important initiatives for our students and to further enrich their academic and co-curricular experiences. This fund is used to support unique initiatives that create a stimulating environment for our Engineering students so that they develop a mindset of success. This, in turn, will allow them to apply their engineering education and deploy their talents in full to develop relevant and pragmatic solutions for the benefit of society. This fund is currently being used to fund entrepreneurship, international and service learning experiences described in sections 4.3 – 4.5.

To date, the Engineering Student Innovation Fund has funded some major initiatives of direct relevance to this proposal. This includes travel expenses incurred by 8 students participating in the 2013 Global Grand Challenges Summit in London and 10 students participating in the 2015 Global Grand Challenges Summit in Beijing. Other initiatives include seed funding for our Engineers Without Borders student society, funding for members of our Society of Women Engineers and National Society of Black Engineers to attend their respective national conferences, and seed funding for our first year design, commercialization and technopreneurship initiatives. We also intend to utilize these funds to provide Dale Carnegie training for Engineering students before they enroll in their first co-operative education experience.