

Operational Document

Grand Challenges Scholars Program

College of Engineering - University of Delaware

Purpose

Responding to the Presidential call for our nation to lead the way in addressing 21st-century Grand Challenges, engineering schools across the United States, have committed to educate a new generation of engineers expressly equipped to meet societal challenges identified through national initiatives including the White House Strategy for American Innovation, the National Academy of Engineering Grand Challenges for Engineering and the United Nations Millennium Development Goals. These challenges include complex yet vital aspirations such as reverse-engineering the brain, making solar energy cost-competitive with coal, engineering better medicines, providing access to clean water for nearly a billion people who lack it, ending extreme poverty and hunger, securing cyberspace, and advancing personalized learning tools that deliver better education to more individuals.

Technology is nothing. What's important is that you have a faith in people, that they're basically good and smart, and if you give them tools, they'll do wonderful things with them.

– Steve Jobs

Program Goals

The Grand Challenge Scholars Program (GCSP) at University of Delaware (UD) is thoughtfully designed:

- To provide our undergraduate students with explicit opportunities to engage with the most pressing societal concerns of our time, articulated through the NAE Grand Challenges of Engineering which broadly focus on issues of Healthcare, Security, Sustainability, and Joy of Living.
- To create a framework and structured support for undergraduate students to deeply engage with the NAE Grand Challenges in their time at UD through intra and extracurricular experiences.
- To recruit and retain a diverse community of undergraduate scholars, activists, and entrepreneurs engaged with specific Grand Challenge issues who are well prepared to continue their engagement beyond graduation from UD.

Core Requirements

The GCSP at UD is similar to a major or minor course of study designation. A student may apply to UD GCSP at the time of admission or may elect to join GCSP any time before the beginning of the final academic year of their undergraduate tenure (this would allow up to 2 academic

semesters, a winter session and two sessions to complete program requirements). Further, this will allow sufficient time for the student to participate in the GCSP Community.

To be designated as a Grand Challenge Scholar, a student must have satisfied the five curricular components outlined by the NAE Grand Challenge Scholars Program. These requirements are provided in more detail in the Detailed Program Requirements section. They are:

1. Grand Challenge Project
2. Interdisciplinary Curriculum
3. Entrepreneurship
4. Global Dimension
5. Service Learning

Administrative Structure

The GCSP will be administered centrally through the Dean's Office in the UD College of Engineering (UD COE). The Associate Dean for Academic Affairs will serve as the permanent Director of UD GCSP and will be responsible for the coordination of all programmatic elements as well as student admission and awarding of degree designations.

Core funding for the program will be provided by the College to support all designated program activities. A budget will be established in the Office of the Associate Dean and Director to implement this program consistent with the activities articulated in this proposal.

The Director will be supported by a faculty committee, with representatives from each engineering department, which will evaluate student work, suggest adjustments to program goals and requirements, and create and maintain the broader GCSP student-faculty community through workshops, sessions, lectures, and other formal events. The Committee will also review and revise annually the list of intra and extracurricular activities that can be applied towards the GCSP program. **Committee members will also serve as faculty advisors for GCSP students and will collectively monitor student progress in the program every semester.**

Student Eligibility & Graduation Requirements

All undergraduate students who have been accepted into an engineering major OR are currently an engineering major are eligible for the UD GCSP Program. A student may apply to the UD GCSP program through the UD course management system (UDSIS), and their application will be reviewed by the Director, with input from the Faculty Advisory Committee. Applications are considered twice annually, during the summer and winter breaks. Considerations for acceptance include the student's overall academic record (recommended 2.5 at time of application) and potential to complete the GCSP requirements before graduation. Students may apply multiple times for the program.

In order to graduate as a UD GCSP Scholar, students must meet minimum requirements for all five of the key elements of the NAE GCSP program (see sections below) as well as have an

overall GPA of 2.5 or better at the time of graduation. Students who have successfully completed the UD GCSP requirements will be recognized on their transcript and at graduation, in a similar manner to those who have completed other affinity programs at the University.

Detailed Program Requirements

UD GCSP Scholars will satisfy the following minimum requirements at the time of graduation in each of the five NAE key elements. Consistent with the national Grand Challenge Scholars Program effort, the UD GCSP requires students identify one or more of the 14 Grand Challenges for Engineering and gain meaningful knowledge and experiences relevant to this Grand Challenge(s) as they complete the requirements for each of the 5 components cited below. The Grand Challenges for Engineering are as follows:

1. Make solar energy affordable
2. Provide energy from fusion
3. Develop carbon sequestration methods
4. Manage the nitrogen cycle
5. Provide access to clean water
6. Restore and improve urban infrastructure
7. Advance health informatics
8. Engineer better medicines
9. Reverse-engineer the brain
10. Prevent nuclear terror
11. Secure cyberspace
12. Enhance virtual reality
13. Advance personalized learning
14. Engineer the tools for scientific discovery

This list of 14 Grand Challenges for Engineering Students will be considered a thematic guide for the work that the GCS will conduct during their undergraduate experience. The GCS may pick a maximum of two GC thematic areas as the focus of their work. Student activities in the 5 components must focus around their selected Grand Challenge(s). Multiple related applications under the same GC theme or multiple related application under different GC themes are allowed (a maximum of two GC thematic areas are allowed as it is difficult to develop much expertise if the focus is too broad). In certain cases, more flexibility will be allowed in satisfying the service component (i.e., STEM-related activities are fine) since it may be challenging to find service activities related to some of the Grand Challenges thematic areas.

Important Note – to ensure that students are exerting sufficient and similar levels of effort, all non-credit bearing or independent activities must be approved by the Director and/or Faculty Advisor to ensure that they are sufficiently robust.

1. Grand Challenge Project

The purpose of the Grand Challenge Project (GCP) is for the scholar to engage in novel, in-depth work related to the Grand Challenges. To satisfy this requirement, a student must consistently engage with the same project focused on a Grand Challenge thematic area for a substantive time period during their upperclassmen years. The GCP is intended as a capstone experience within the GCSP program. To fulfill this requirement the student must:

- Complete 4 credit hours capstone (senior) engineering design experience at 400-level or above that aligns with one or more Grand Challenge areas.

OR

- Complete 6 credit hours of optional independent study (300 or 400 level) with UD faculty on the same research project that aligns with a NAE Grand Challenge area.

OR

- Two winter/summer optional internships with UD faculty on the same research project that aligns with a NAE Grand Challenge area. One internship and 3 credit hours of independent study may also satisfy this requirement.

Example: In 2016, a group of senior year students in mechanical, biomedical, and environmental engineering in the Engineering Senior Design (MEEG401/BMEG450) were tasked by the USDA with designing and fabricating a portable decontamination system for visiting veterinarians. This project aligned with both Sustainability, Healthcare, and Security Grand Challenge areas. The team devoted 1200 person-hours over the course of a 6-credit hour, one semester course towards the project and created a fully functional prototype that is now being advance internally within the USDA.

2. Interdisciplinary Curriculum

Given that the Grand Challenges themselves are inherently interdisciplinary, GCSP students must complete a minimum amount of coursework that involves interdisciplinary technical expertise and collaboration. To fulfill this requirement the student must:

- Complete 2 credit hours of Introduction to Engineering (EGGG101), which inherently requires substantive interdisciplinary collaboration related to Grand Challenges OR 2 credit hours of equivalent introductory First Year Experience course that aligns with Grand Challenges and requires group work. The latter requires a statement from the student describing alternative course and how it satisfies interdisciplinary requirements in the Grand Challenge area, which must be endorsed by the course instructor.

AND

- Complete 3 credit hours of 300 or 400 level coursework that involves interdisciplinary, project-based teamwork on Grand Challenge issues. Students may choose courses from a pre-approved list developed by the GCSP Committee.

Example: A mechanical engineering student completed EGGG101: Introduction to Engineering in fall 2016, which involved multiple group projects with engineering students from other disciplines. With their team, the student prototyped a kinetic energy harvesting system

(Sustainability) and a password protection app (Security); and lecture content in the course included introductory concepts from each major engineering discipline as well as business and entrepreneurship. In their sophomore year, the student completed LEAD300: Leadership, Creativity, and Innovation, an interdisciplinary course housed in the Political Science Department that provides students with the theoretical bases of leadership, creativity, and innovation that inform the effective practice of leadership. The student again worked in an interdisciplinary team, this time with non-engineering students, to develop a social program that reduced the stigma associated with physical deformations of the face and hands amongst children.

3. Entrepreneurship

GCSP students must build awareness and experience in entrepreneurship, defined as the commercialization of a product, process, service, through formal coursework and experiential learning. GCSP students may extend other GCSP core requirements, such as the GCP, into their entrepreneurial experience. To fulfill this requirement the student must:

- Complete 3 credit hours of 300 or 400 level coursework in the UD Entrepreneurship program (ENTR course designation).

AND

- Summer/winter internship involving active entrepreneurship and/or commercialization efforts of new technology in one of the Grand Challenge thematic areas. Capstone (Senior) engineering design may count towards this requirement so long as the faculty instructor certifies that the project involves an entrepreneurship and/or commercialization effort.

Note - A student's Senior Design project cannot count for both GCP and Entrepreneurship requirements, unless Senior Design is taken as an honors course with an additional individual contribution to the project.

Example: Two engineering students complete a winter internship (MEEG366) to advance their novel construction-themed toy design, created in an earlier design class, to a minimum viable prototype, appropriate to "pitch" in a start-up competition. At the conclusion of the internship, the students are awarded a small grant for customer discovery and enroll in ENTR350: Introduction to Entrepreneurship, to learn the Lean Start-up Method for creating a viable commercialization plan for their product.

4. Global Dimension

GCSP students must engage with organizations and/or research and service projects outside of the US. To fulfill this requirement, students must:

- Complete at least two years of active involvement in student organizations or established NGO's that engage with communities outside of the US, e.g., Engineers Without Borders or Red Cross. Student must provide evidence of active involvement (at a level equivalent to an

organizational officer, project manager, etc.) as a written statement endorsed by organizational leadership.

OR

- Summer/winter internship on faculty-supervised research that engages with communities outside of the US. Student must submit a statement describing engagement, which is to be endorsed by the faculty supervisor for the research.

Example: An environmental engineering student is a member the UD chapter of Engineers Without Borders. In their first year, the student is engaged in the paper design and design justification for a new water filtration system in a rural village in South America. The student remains engaged with the organization throughout their time at UD, eventually becoming the treasurer for the club and supervising a component of the system installation on site in their senior year.

5. Service Learning

GCSP students must also commit to serving their local community, that is, in proximity to UD. To fulfill this requirement, students must:

- Participate in UD Service Learning Scholars Program, including winter/summer internship and 3 credit independent study with faculty supervision. The UD Service Learning Program was recognized nationally with the Community Engagement Classification from the distinguished Carnegie Foundation for the Advancement of Teaching.

OR

- Complete at least two years of active involvement in student organizations or established NGO's that engage with underserved communities in proximity to UD. Student must provide evidence of active involvement (at a level equivalent to an organizational officer, project manager, etc.) as a written statement endorsed by organizational leadership.

Example: A mechanical engineering student is a member of The MESS (Mechanical Engineering Student Squad), an organization dedicated to recruiting, retaining, and advancing mechanical engineering students within the UD community. Beginning their sophomore year, they conducted demonstrations and workshops at local middle and high schools to promote the mechanical engineering profession, and they served as a near-peer mentor for first semester freshmen in the major. The student remained active in MESS throughout their time in the program, dedicating approximately 20 hours per semester in service to the K12 and UD community.