

Grand Challenges Scholars Program

at

The Catholic University of America

Guidelines for students and faculty mentors

Spring 2017

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1. Introduction

Over the last several hundred years, the developed world has seen dramatic improvements in quality of life, increases in life expectancy, improved healthcare, more time for leisure, improved economic conditions, the development of the ability to communicate around the globe “instantaneously”, increased mobility among peoples, increased trade, greater access to more nutritious food, easy access to energy, impressive strides in basic scientific understandings, *inter alia*. Much of what has made these advances possible has been the impressive development of and leaps in technology made possible by engineering and its practitioners.

Unfortunately, however, history shows that the benefits of technology are not always uniformly distributed, and that the effects of technology are not always beneficial. Peoples in the developing world have not and do not always share in the same benefits realized by and through technology and engineering as have and do peoples in the developed world. In fact, peoples and resources of the developing world are often exploited by peoples of the developed world for the benefit of the developed world. Technology and engineering made possible in the last century the killing of hundreds of millions of people through conflict and war. They share in some of the blame for developing economic systems that often exploit weaker members of society and often lead to the concentration of economic power in “the hands of a few”. They can share in some of the blame for exploiting natural resources and negatively impacting ecosystems and the environment. Technology and engineering have made enormous contributions toward the betterment of humanity while at the same time, unfortunately, making possible the exploitation of resources, the environment, and peoples.

There is a strong need for broad-thinking, ethically grounded, and liberally educated engineers capable of addressing and solving the interdisciplinary, complex, and broad challenges facing *all peoples* by cutting across cultures, ecosystems, and political and economic systems. As stated on the National Academy of Engineering Grand Challenges website (engineeringchallenges.org), “As the population grows and its needs and desires expand, the problem of sustaining civilization’s continuing advancement, while still improving the quality of life, looms more immediate. ... In each of these broad realms of human concern — sustainability, health, vulnerability, and joy of living — specific grand challenges await engineering solutions.”

In recognition of this need, in February 2008, the National Academy of Engineering promulgated its fourteen Grand Challenges (GC) for Engineering for the 21st Century:

- Make solar energy economical
- Provide energy from fusion
- Develop carbon sequestration methods
- Manage the nitrogen cycle
- Provide access to clean water
- Restore & improve urban infrastructure;
- Advance health informatics
- Engineer better medicines
- Reverse-engineer the brain
- Prevent nuclear terror
- Secure cyberspace
- Enhance virtual reality
- Advance personalized learning
- Engineer the tools of scientific discovery

The CUA School of Engineering has established its Grand Challenges Scholars Program (GCSP), with approval from the National Academy of Engineering, to educate engineering

leaders for the 21st Century who will rise to these challenges. The most motivated students who demonstrate strong academic potential are invited to apply for selection as CUA Grand Challenges Scholars, who will be guided by their Grand Challenges faculty mentors through a rigorous curriculum incorporating interdisciplinary work, entrepreneurial effort, a global dimension, and service learning, culminating in a project engaging with one of the 14 Grand Challenges.

2. Eligibility and Selection of Grand Challenges Scholars

To apply to be a Grand Challenges (GC) Scholar at CUA, a student must submit electronically to the GCSP Director during the sophomore year¹, no later than the beginning of Spring Break:

- 1) A copy of an unofficial transcript demonstrating a minimum cumulative GPA of 3.5.
- 2) A personal statement of between 750 and 1500 words expressing why the student wishes to be a GC Scholar. In this statement, a discussion of at least two Grand Challenges must be included.
- 3) Evidence that a School of Engineering (SOE) fulltime faculty member has agreed to serve as the student's GC mentor.
- 4) Recommendation letters from two faculty members in the SOE.
- 5) A proposed GC Curricular Plan encompassing the five curricular elements described below in Section 4.

Selection of GC Scholars will be made by the GCSP Committee and selected GC Scholars will be informed prior to the completion of their sophomore year.

3. Grand Challenges Faculty Mentors

Any full-time CUA School of Engineering faculty member is eligible to serve as a GC mentor. Each student applying for the program must contact an appropriate faculty member who is willing to serve as a GC mentor. During the application process, the faculty member advises the student on preparing an individualized GC Curricular Plan. If the student is accepted as a GC Scholar, the GC mentor meets with the GC Scholar at least once each semester, and submits a brief written report to the GCSP Director each semester describing the GC Scholar's progress.

If a faculty member is unable to continue in their role as a GC mentor for any reason, they must notify the GCSP Director immediately. The GCSP Director will work with the student to identify a new GC mentor.

¹ Defined as having completed at least 30 semester credit hours (SCH) at CUA, with at least half in math, science, and engineering, or if a new transfer to CUA be enrolled in a minimum of four sophomore-level math, science, and engineering courses during the first or second semester at CUA.

4. Grand Challenges Curriculum

As part of their application for the GC Scholars Program, a CUA Engineering student must develop an individualized curricular and meta-curricular plan to meet each of the five GC curricular elements described below.

1. Project or Research Activity Engaging a GC Theme or Challenge

The student must complete at least one of the following:

- a. An approved two-semester senior capstone design sequence with grades of B or better where the design project is significantly related to a GC theme or challenge. Note: the final senior design project includes a presentation, poster, and display presented to and judged by a large group of persons both internal and external to CUA, including industry professionals and practicing engineers.
- b. An approved research experience consisting of least two units² in a CUA laboratory on a project related to a GC theme or challenge.

2. Interdisciplinary Curriculum

The student must complete all of the following:

- a. Given that the SOE is one of twelve schools in a liberal arts university and given CUA's particular mission and emphasis on theological and philosophical studies, the student must complete with grades of B or better three courses in philosophy and three courses in theology, namely, PHIL 201: Classical Mind; PHIL 202: Modern Mind; PHIL 362: Engineering Ethics; TRS 201: Faith Seeking Understanding; and two other TRS courses chosen by the student.
- b. Complete with a grade of B or better ENGR 401: Senior Seminar. Note: ENGR 401 includes seminars related to professional topics of current societal interest, ethics, and the fundamentals in engineering exam.
- c. Document attendance at a minimum of 10 seminars offered on CUA's campus or throughout the DC metropolitan area at other universities, at think tanks, at government organizations, at non-profit organizations, etc. At least half of the seminars must be related to a GC theme or challenge.

3. Entrepreneurship

The student must complete at least one of the following:

- a. A minimum 10 week internship with the Energetics Technology Center (ETC) incubator, TechFire (<http://www.etcmd.com/media/techfire-news/>). Note: TechFire is located in Southern Maryland and is managed by ETC whose CEO is on the SOE's development board.
- b. Successfully achieve grades of B or better in MGT 323: Management – Theory and Practice and MGT 372: Entrepreneurship and Capital Venturing.

² A “unit” is defined to be the taking of ENGR 496: Special Topics during a regular academic semester or 10 weeks of summer internship/work experience.

- c. Successfully achieve a grade of B or better in CE 583: Engineering Entrepreneurship, Sustainability, and Lean Methods
- d. Successfully submit through CUA's Office of Technology Transfer (<http://sponsoredresearch.cua.edu/regulatoryinformation/Technology-Transfer.cfm>) an invention disclosure related to one of the GC themes or challenges.

4. Global Dimension

The student must complete at least one of the following:

- a. A study abroad experience lasting one semester at Hong Kong Polytechnic (<http://engineering.cua.edu/studyabroad/outbound.cfm>).
- b. A study abroad experience lasting one semester at another CUA-affiliated study abroad institution. The study abroad experience must be pre-approved by the GCSP Committee and CUA's Study Abroad Office (<http://cuabroad.cua.edu>).
- c. Participate in a minimum two-semester international project sponsored by CUA's Engineers Without Borders (EWB) club, which must culminate in an international trip lasting a minimum of 7 days.
- d. Participate in a minimum of two Campus Ministry sponsored international mission trips (<http://service.cua.edu/trips/index.cfm>).
- e. An internship of a minimum of 10 weeks duration which has a significant international dimension. The international dimension must be documented.
- f. Spend a minimum of 10 weeks working in a research laboratory at one of CUA's international partner universities (e.g., ones located in Taiwan, Vietnam, Hong Kong, India, Chile, Mexico, Italy) or an international university approved by the GCSP committee. The research experience must be related to a GC theme or challenge.
- g. Participate in combinations of parts of (c)-(g), though the combinations must be approved by the GCSP committee.

5. Service Learning

The student must complete at least one of the following:

- a. Participate in a Campus Ministry sponsored mission trip (<http://service.cua.edu/trips/index.cfm>).
- b. Participate in a minimum of 60 documented hours of community service through Campus Ministry's Weekly Service Opportunities (<http://service.cua.edu/cuaserviceopportunities/weekly.cfm>).
- c. Participate in a minimum of 60 documented hours of community service through the DC Reads (<http://dcreads.cua.edu/>) program.
- d. Participate in a minimum of 60 documented hours of community service through Campus Ministry's "Organizing a Service Project" (<http://service.cua.edu/resources.cfm>).

- e. Participate in a minimum of 60 documented hours of community service through CUA's Engineers Without Borders (EWB) club.
- f. Participate in combinations of parts of (b)-(e), though the combinations must be approved by the GCSP committee.

5. Responsibilities of Grand Challenges Scholars

Each GC Scholar should meet with their GC mentor at least once each semester. The GC mentor will provide feedback on progress towards completing the student's GC Curricular Plan, but it is the GC Scholar's responsibility to complete each aspect of the plan.

To remain a GC Scholar in good standing, a student must

- 1) maintain a minimum cumulative GPA of 3.2.
- 2) maintain an online portfolio of relevant work and experiences, updated as a minimum once per semester by the last day of classes, as described below in Section 7.
- 3) submit a written report once per semester to the GCSP Director summarizing progress toward completing the GC Scholar Program by the time of graduation. The report must be submitted by the last day of classes.

If any of these items are not satisfied in a given semester, the student will be placed on probation for the following semester. The student will no longer be considered to be a GC Scholar if:

- 1) at the conclusion of the semester on probation the minimum cumulative GPA is not restored to 3.2.
- 2) by the end of the sixth week of the semester on probation, the student has not completed the missing item(s) [2 or 3 above], if any.

If the student has been deemed to no longer to be a GC Scholar, the student can reapply after one full semester from the time of notification that the student is considered to no longer be a GC Scholar. To reapply, a student must submit to the GCSP Director:

- 1) A copy of an unofficial transcript demonstrating a minimum cumulative GPA of 3.2.
- 2) A letter of between 750 and 1500 words explaining why the student wishes to be considered once again a GC Scholar and detailing how the student will be successful on the second attempt.
- 3) A letter of support from the student's GC mentor.
- 4) An updated GC Curricular Plan encompassing the five curricular elements.

6. Assessment Plan and Completion of the Program

At the end of each semester, the GCSP Committee will review all online portfolios and GC mentor reports and will provide written feedback to all GC Scholars. A copy of each GC Scholar's individualized GC Curricular Plan and copies of the GCSP Committee's written comments will be kept in the student's academic folder.

A special program track will be created in the student's online academic record through Cardinal Students³.

On successfully completing all elements of the GC Scholars program at CUA, a notice detailing such will be included on the student's transcript. In addition, the students will be acknowledged at Commencement and will receive a plaque from the SOE recognizing their achievement.

7. Guidelines for Online Portfolio

Each GC Scholar must maintain an electronic portfolio that must be updated at least once per semester by the last day of classes. The portfolio must be emailed to the GCSP Administrator (Associate Dean) by the last day of classes each semester. The portfolio must be a continuous, "living" document, that is, it is to be updated on an on-going basis. When the portfolio is submitted to the GCSP Administrator, it must be submitted in two versions: (1) a Word file that shows changes only since the last submission (use "Track Changes" feature) and (2) a second Word file where there are no track changes, that is, a "clean" version of (1).

The portfolio should include the following 7 components:

1. **Cover Page:** Include your name, major, expected graduation date, date, name of your GC Mentor, and GCSP theme.
2. **Project or Research Activity:** Include a report that describes your project. As a minimum, your report should include: Abstract, Nomenclature, Introduction and Background (Including Literature Review), Methodology, Results and Discussion, Conclusions, References, and Appendixes.
3. **Interdisciplinary Curriculum:** Document how you have satisfied (or will satisfy) the interdisciplinary components of the GC Scholars Program. For aspects that will be completed in future semesters, please provide an expected timeline for completion.
4. **Entrepreneurship:** Document how you have satisfied (or will satisfy) the interdisciplinary components of the GS Scholars Program. For aspects that will be completed in future semesters, please provide an expected timeline for completion.

³ CUA's online student record keeping system. See <http://cardinalstudents.cua.edu>

5. **Global Dimension:** Document how you have satisfied (or will satisfy) the global dimension of the GS Scholars Program. For aspects that will be completed in future semesters, please provide an expected timeline for completion.
6. **Service Learning:** Document how you have satisfied (or will satisfy) the service learning dimension of the GS Scholars Program. For aspects that will be completed in future semesters, please provide an expected timeline for completion.
7. **Overall Comments:** Please comment on your overall achievement/shortcomings of all components of the GC Scholars Program. Please comment on your joys and struggles. Please comment on what assistance you need from the GCSP Committee and/or GC Mentor in order for you to satisfy all aspects of the GC Scholars Program by the time of graduation? Please comment on what parts of the GC Scholars Program you have liked and have not liked, and provide reasons for your comments. Please comment on how the GC Scholars Program could be improved.