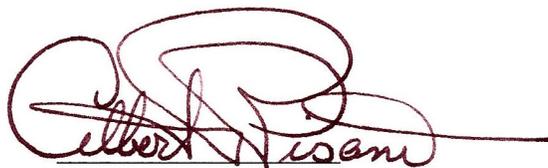


**UNIVERSITY OF CALIFORNIA, SAN DIEGO  
JACOBS SCHOOL OF ENGINEERING**

**NATIONAL ACADEMY OF ENGINEERING  
GRAND CHALLENGE SCHOLARS PROGRAM  
PROPOSAL**



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## PROPOSAL

### **UC SAN DIEGO JACOBS SCHOOL OF ENGINEERING NAE GRAND CHALLENGE SCHOLARS PROGRAM**

#### VISION

The mission of the Jacobs School of Engineering is to educate tomorrow's technology leaders, conduct cutting edge research and drive innovation, and transfer discoveries for the benefit of society. The National Academy of Engineering's Grand Challenges provide a valuable framework for enacting that mission, and deepening undergraduate students' commitment to the study and practice of engineering. The Jacobs School of Engineering Grand Challenge Scholars Program (GCSP) will provide selected engineering undergraduates with the educational and professional opportunities to develop the broad portfolio of skills necessary to address the most pressing engineering challenges of the 21st century: those articulated by the National Academy of Engineering (NAE) in the form of the Grand Challenges. The opportunities offered through the GCSP are designed to both complement and transcend the student's major course of study to ensure that all who complete the GCSP are intellectually, technically, socially, and ethically prepared to engage with one or more of the Grand Challenges. Moreover, the GCSP has been designed to both reinforce and build upon the formidable educational and research resources of UC San Diego, in general, and the Jacobs School, in particular, such as the Global TIES humanitarian engineering program, the Gordon Engineering Leadership Center, the IDEA Student Center (Inclusion, Diversity, Excellence, and Advancement), the Moxie Center for Undergraduate Entrepreneurship, and the Team Internship Program (TIP). These initiatives will be described in greater detail below.

Founded in 2004 as TIES – Teams in Engineering Service, a course-based service learning program focused on local community development projects advised by renowned UC San Diego faculty, **Global TIES** (<http://globalties.ucsd.edu>) has evolved into the Jacobs School's nationally recognized humanitarian engineering and social innovation program. The program has continued its focus on local community development, but in 2010, it expanded its mission to include humanitarian engineering projects in developing countries, such as Mexico, Burundi, Fiji, and the Philippines. Since its inception, Global TIES has grown dramatically in both enrollments and diversity, attracting increasing numbers of students from majors both within and beyond engineering. It routinely enrolls a far greater percentage of women than is represented in the Jacobs School's undergraduate population as a whole and frequently enrolls a greater percentage of underrepresented minority students. Moreover, it has become increasingly popular with international students. The Global TIES courses may be taken for technical elective credit in nearly all of the engineering majors and are an integral part of the undergraduate Business minor in the UC San Diego Rady School of Management. Outcome measures indicate that the program is instrumental in helping students develop professional and technical skills, as well as leadership abilities, collaboration skills, commitment to future service, appreciation for diversity, and knowledge and understanding of local, national, and global issues. Perhaps most significantly, after just one quarter in the program, students report an increase in their belief that they can "make a difference in the world." Global TIES is one of three programs to earn the UC San Diego a place on President Barack Obama's Honor Roll of Higher Education Community Service for each of the past four years. Moreover, it has twice been recognized by the Clinton Global Initiative University.

Through its Gordon Scholars and Engineering Leadership Awards, the Jacobs School's **Gordon Engineering Leadership Center** identifies and celebrates talented individuals with leadership potential (<http://www.jacobsschool.ucsd.edu/GordonCenter/>). More importantly, the Center exposes students to the advice, experience and attitudes of proven engineering leaders through training events including workshops, leadership forums, and summer school programs. Undergraduate students can participate in the Gordon Center's innovative courses on engineering leadership, project management and interdisciplinary design. These courses complement the existing engineering curricula by introducing a focus on aspects of engineering leadership, such as project management, team engineering, ethics and innovation.

The Jacobs School's **IDEA Student Center** (Inclusion, Diversity, Excellence, and Advancement) has as its stated goals to: (1) increase K-14 student knowledge and interest in engineering and motivate them to pursue higher education in an engineering field; (2) increase applications and enrollments of historically underrepresented groups to the Jacobs School of Engineering; (3) improve the success, retention, and graduation of historically underrepresented and economically or socially disadvantaged students; and (4) promote participation of undergraduate students in engineering research as a means of enhancing academic performance, developing key relationships, and increasing retention (<http://www.jacobsschool.ucsd.edu/student/>). To these ends, the IDEA Student Center offers an "Orientation to Engineering" series of courses for first- and second-year students, designed to orient students to the Jacobs School and to the practice of engineering. A section of these courses will be reserved for students interested in the CGSP and will use the Grand Challenges as a unifying theme. It is hoped that collaboration with the IDEA Student Center will also help ensure a diverse pool of applicants for the GCSP.

The centerpiece of the Jacobs School's new **Moxie Center for Undergraduate Entrepreneurship** is the "Moxie Incubator," which fosters the incubation/acceleration of undergraduate ideas (<http://www.jacobsschool.ucsd.edu/moxiecenter/>). The Incubator provides lab and meeting space for use by program participants, as well as access to mentoring on engineering and commercialization issues from the technical and business communities. The Moxie Center provides formal and informal courses that help undergraduates turn ideas into innovations for commercial and/or humanitarian purposes. In addition to accepting cohorts of students into the incubator, the Moxie Center has established an "Entrepreneur's Academy" that provides entrepreneurship education to interested undergraduates in the form of a series of no-cost workshops.

Finally, the Jacobs School's **Team Internship Program** (TIP) provides summer team internships as part of the Jacobs School's effort to enhance students' education through real-world engineering experiences in a team setting. Students work on-site with industry partners as part of a multi-disciplinary team focused on a clearly defined and significant industrial project. Many of these projects bear a direct relationship to one or more of the Grand Challenges. For further information on TIP, see ([http://www.jacobsschool.ucsd.edu/external/external\\_cap/cap\\_team\\_intern/](http://www.jacobsschool.ucsd.edu/external/external_cap/cap_team_intern/)).

The GCSP will leverage the educational and professional opportunities offered by each of these initiatives to help each scholar develop a GC portfolio of activities across the five GCSP curricular components: (1) project or research activity engaging a GC theme or problem; (2) interdisciplinary curriculum; (3) entrepreneurship; (4) global dimension; and (5) service learning. The Grand Challenges will be viewed as opportunities to enact the Jacobs School's mission of driving innovation for the direct "benefit of society." Given this focus on social innovation, the Jacobs School's GCSP will be directed by the Executive Director of the Global TIES program and overseen by a faculty committee with representation from each of the Jacobs School's six departments, Bioengineering, Electrical and Computer Engineering, Computer Science and Engineering, Mechanical and Aerospace Engineering, NanoEngineering, and Structural Engineering.

## SELECTION OF SCHOLARS

The Jacobs School will promote the GCSP to prospective students prior to enrollment through its many outreach and recruitment efforts, including the COSMOS program (California State Summer School for Mathematics and Science) (<http://www.jacobsschool.ucsd.edu/cosmos/>). The COSMOS program is a four-week residential program in which rising ninth- through twelfth-graders work side by side with UC San Diego faculty on research and design projects, many of which relate to the Grand Challenges. The program will also be promoted via the Jacobs School web site, through Admit Day and orientation events, through first-year courses, and through the IDEA Center's activities and student organizations to ensure that we attract a large and diverse pool of candidates.

We are particularly committed to capturing the interest and imagination of first- and second-year students. We see the first and second years as a time when prospective scholars can learn about the profession of engineering, the Grand Challenges, and begin to develop a degree plan that has one or more of the Grand Challenges at its core. First- and second-year students, as well as new transfer students, will be invited to attend an information session during Fall Quarter that will introduce them to the GCSP and outline the application process. This event will also introduce students to a representative sample of prospective Grand Challenge Mentors and discuss ways of approaching faculty with whom students are interested in working. Moreover, over the first few years of the program, we hope to establish an inventory of prospective faculty mentors, their research interests, projects advised, etc. Grand Challenge Scholars will not be limited to this list, but we hope that it will serve as a resource for students looking for mentors.

Students interested in the GCSP will be encouraged to immediately begin developing their Grand Challenge Portfolio that will be submitted as part of their application to the program. Initial activities might include a series of one-unit engineering courses (referenced above) that will introduce students to the Jacobs School, the Grand Challenges, and the practice of engineering. These courses will also help students develop research and project skills that will enable them to successfully complete their Grand Challenge Commitment project.

In the first of these courses, students will be introduced to the Jacobs School and the practice of engineering with the Grand Challenges and their potential for social innovation as a unifying theme. The second and third courses will introduce students to project management and research skills, again with the Grand Challenges as a thematic focus. Each course will carry one unit of academic credit.

First- and second-year students interested in applying for the GCSP will also be encouraged to participate in the Global TIES program. Global TIES is based on a course structure. ENG 100D, Design for Development, introduces students to team engineering and human-centered design within a humanitarian context and includes a significant team project designing a solution to a real problem for a nonprofit client. Each section of ENG 100L, Design for Development Lab, corresponds to a long-term Global TIES project in which a student-directed but faculty-advised, interdisciplinary team of students designs, builds, tests, and deploys an engineering and/or technology solution for one of the program's nonprofit partners. ENG 100D carries four units and ENG 100L carries two units of academic credit, and students may take the latter course for a total of six quarters (12 units). As mentioned above, these courses have been integrated as technical electives into nearly all of the engineering majors and form part of the undergraduate Business minor.

Students may apply to the GCSP program in the Winter Quarter of their second year. (Transfer students may apply during the Winter Quarter of their first year). Application to the program will be open to all engineering majors in good academic standing. The number of scholars selected will be dependent on funding, but it is anticipated that an inaugural class of 15-20 Scholars would be selected in Spring 2015. A stipend will be awarded to students who successfully complete the program. Programmatic support will also be available to help students fulfill their Grand Challenge Commitments, attend regional and/or national meetings, and engage in academic and networking events with other Scholars.

The most competitive applications will be those that demonstrate, through the Grand Challenge Portfolio, a sustained engagement with one or more of the Grand Challenges. The Portfolio should include all Grand Challenge-related curricular and co-curricular activities.

Successful applications will also include a preliminary proposal outlining the Grand Challenge(s) the prospective Scholar wishes to address through their Grand Challenge Commitment and initial plans for doing so. This will include a proposed plan of course-based and other activities in each of the five Grand Challenge Curricular Components, as well as a letter of recommendation from a UC San Diego academic or research professional who has agreed to serve as the student's Grand Challenge Mentor, if the student is selected as a Grand Challenge Scholar.

Applications will be reviewed by a GCSP selection committee, comprised of faculty, staff, and advanced students. Students will be notified of their selection status in Spring Quarter.

In the Fall and Winter Quarters following their selection, as part of their Grand Challenge Commitment, Scholars will be expected to design and build a prototype solution to a problem related to the Grand Challenges. This may be done individually, but Scholars will be encouraged to work in teams with other scholars. In Spring Quarter, they will be expected to enter this prototype into a Grand Challenge Design Competition. To this end, Scholars will be encouraged to take advantage of the opportunities available in the Moxie Center, such as the incubator and Entrepreneur's Academy, and it is expected that the Grand Challenge Design Competition will take place in conjunction with the Moxie's Center's annual Zahn Prize Competition. (In 2014, the Moxie Center, in collaboration with Global TIES, added a social innovation track to this annual design competition.)

During the fourth year, Scholars will participate in a special two-unit "Grand Challenge Senior Seminar," in which they will have the opportunity to reflect upon their work, consolidate their learning, and plan for the future. The seminar will focus on career development and preparation for graduate school and/or positions in the profit and nonprofit sectors. Scholars will also be encouraged to develop ways to produce and market their prototypes, again utilizing the resources of the Moxie Center. At the conclusion of the program, Scholars will be required to write Grand Challenge Capstone professional paper and make a Grand Challenge Capstone presentation. The presentations will coincide with the annual Grand Challenge Design Competition.

Scholars will be required to review their progress each quarter with their faculty mentor and the Director of the GCSP.

### **CURRICULAR COMPONENTS**

Candidates for the GCSP must submit a detailed Grand Challenge Portfolio with their application. Moreover, they must include a preliminary proposal outlining future course-based and co-curricular

activities in each of the five Grand Challenge Curricular Components. Aside from the Grand Challenge Commitment Project and the Grand Challenge Senior Seminar, there are no prescribed courses or activities, allowing students to personalize their studies, using the Grand Challenges as a unifying theme. However, UC San Diego, in general, and the Jacobs School of Engineering, in particular, offer a rich array of curricular and co-curricular opportunities in which Scholars are recommended to engage. The Scholar's portfolio will be reviewed quarterly by the Grand Challenge Mentor and Director to ensure that it reflects the necessary depth and breadth, as well as curricular connectivity, and that the Scholar is making satisfactory progress. Examples of activities that may be used to create the Grand Challenge Portfolio are listed below. These activities are not intended to be orthogonal. Indeed, connectivity among the curricular components is encouraged.

**1. Project or Research Activity Each Scholar must complete at least one activity *in addition to the required Grand Challenge Commitment Project*, and all activities must be approved in advance by the Mentor and Director.**

- Grand Challenge Commitment Project (Fall, Winter, Spring Quarters following selection) (required of all Scholars)

AND at least one of the following activities:

- Global TIES – ENG 100A and ENG 100L, Team Engineering and Team Engineering Lab
- TIP (Team Internship Program) or another industrial or non-profit internship (Faculty mentor must agree to supervise. Given the short-term nature of summer internships, this must be combined with at least one other project or research activity.)
- PRIME (Pacific Rim Undergraduate Experiences) - an international summer research internship program (<http://biology.ucsd.edu/education/undergrad/research/scholarships/prime.html>)
- Pre-approved research experience on a faculty member's research project

**2. Interdisciplinary Curriculum – Each Scholar must complete 16 units (e.g., four 4-unit courses or equivalent. At least one of these courses must be upper division). Courses may be taken to fulfill General Education and other requirements. Suggested courses might include a selection from the following, subject to the approval of the Mentor and the Director:**

Biological Sciences

- 18: Human Impact on Environment
- 38: Dementia, Science, and Society
- 174: Ecosystems and Global Change
- 176: Conservation and the Human Predicament

Cognitive Science

- 10: Cognitive Consequences of Technology
- 11: Minds and Brains
- 17: Neurobiology or Cognition
- 120: Human-Computer Interaction

### Critical Gender Studies

- 101: Gender, Modernity, and Globalization
- 109B: Gender and Information Technology

### Environmental Studies

- 30: Environmental Issues: Natural Sciences
- 110: Environmental Law

### Environmental Systems

- 10: Introduction to Environmental Systems
- 90: Perspectives on Environmental Issues
- 120: Science and Environmental Writing
- 124: Environmental Challenges: Science and Solutions
- 150: Environmental Perils

### Ethnic Studies

- 102: Science and Technology in Society: Race/Gender/Class

### Human Development

- 1: Introduction to Human Development
- 110: Brain and Behavioral Development
- 121: The Developing Mind

### International Studies

- 101: Culture and Society in International Perspective

### Management

- 16: Personal Ethics at Work
- 110: Business: Innovative Enterprise Creation and Management
- 164: Organizational Leadership
- 166: Business Ethics and Corporate Responsibility
- 174: Supply Chain and Operations Management

### Sociology

- 20: Social Change in the Modern World
- 30: Science, Technology, & Society
- 40: Sociology of Healthcare Issues
- 121: Economy and Society
- 130: Population and Society
- 132: Gender and Work

- 133: Immigration in Comparative Perspective
- 134: The Making of Modern Medicine
- 135: Medical Sociology
- 138: Genetics and Society
- 147: Organizations, Society, and Social Justice
- 149: Sociology of the Environment
- 168E: Sociology of Science
- 171: Technology of Science
- 185: Globalization and Social Development

#### Urban Studies

- 1: History of U.S. Urban Communities
- 2: Urban World Society
- 3: The City and Social Theory

### 3. **Entrepreneurship**

- MGT 110: Business: Innovative Enterprise Creation and Management
- Pre-approved combination of courses/workshops offered by the Moxie Center and/or Von Liebig Entrepreneurism Center (<http://www.jacobsschool.ucsd.edu/vonliebig/education/index.shtml>)
- Participation in the Moxie Center's Entrepreneur's Academy
- Acceptance into the Moxie Center's incubator program
- Completion of the Business Minor

### 4. **Global Dimension**

- Participation in PRIME
- Participation in a UC San Diego Global Seminar, Education Abroad Program, or other pre-approved study abroad program. Global Seminar is a five-week, eight-unit summer study abroad experience led by a UC San Diego faculty member.
- Participation in a minimum of two quarters of Global TIES (ENG 100L) including an international field experience
- Participation in a pre-approved TIP international internship
- Participation in a pre-approved international Alternative Spring/Summer Break experience
- Participation in a pre-approved international independent or group study/service experience

### 5. **Service Learning**

- Participation in a minimum of two quarters in Global TIES
- Participation in one or more pre-approved Alternative Spring/Summer Break experiences
- Participation in a pre-approved community service experience (at least 120 hours)

**Curricular Connectivity** - It will be the Scholar's responsibility to document how their Grand Challenge Portfolio demonstrates intellectual and thematic connectivity across the five curricular components and relates to a Grand Challenge theme or problem.

**Grand Challenge Mentor** – Each Grand Challenge Scholar candidate must engage a Grand Challenge Mentor who, along with the Director, will guide the completion of his/her Grand Challenge Portfolio. A Grand Challenge Mentor is chosen by a candidate to provide support throughout the duration of the program. The Grand Challenge mentor must be a UC San Diego academic or research professional whose work relates to one or more of the Grand Challenges. He/She must write a letter of recommendation (to be submitted with the candidate's application) that indicates his/her willingness to serve as a Grand Challenge Mentor and to provide guidance and support throughout the program, if the candidate is selected as a Scholar. The Mentor will also certify the Scholar's successful completion of the Grand Challenge Portfolio, Grand Challenge Commitment Project, and Grand Challenge Capstone Paper and Presentation.

### ASSESSMENT AND TRACKING

As mentioned above, Scholars will meet quarterly with their Grand Challenge Mentor and the Director. They will document their program-related activities in an online version of their Grand Challenge Portfolio. This "e-portfolio" will allow them to not only record their activities, but to upload progress reports, reflections, and program-related media, etc. The Director as well as the student's Grand Challenge Mentor will be able to view posted documentation and provide feedback between meetings.

The Director, under the direction of the faculty oversight committee and in collaboration with the Grand Challenge Mentors, will be responsible for:

1. Recruiting of prospective Grand Challenge Scholars – as mentioned above, this will include introducing the Grand Challenges and the GCSP to prospective students and first- and second-year students, through admissions and orientation events, first-year courses, and IDEA Center activities and student organizations;
2. Management and oversight of the selection process for Scholars;
3. Mentoring Scholars and monitoring their progress;
4. Approving contents of portfolios, in conjunction with the faculty mentor;
5. Documenting the names and accomplishments of Scholars and conveying this information to NAE Grand Challenge Steering Committee as part of the required annual report;
6. Assisting in longitudinal tracking of Grand Challenge Scholars in cooperation with the NAE Grand Challenge Steering Committee.

To ensure the success of the Jacobs School's GCSP, the Director will attend workshops and summits, prepare an annual report of programmatic activities and accomplishments, and participate in the NAE GCSP electronic community to exchange best practices.

**APPENDIX A**

**HYPOTHETICAL GRAND CHALLENGE SCHOLAR PORTFOLIO**

Grand Challenge Scholar: Alberta Einstein

Major: Electrical Engineering

Grand Challenge: Make solar energy economical

Mentor: Charles Tu, Ph.D.

Grand Challenge Capstone Paper/Presentation: One Lantern per Bure – Providing Affordable Light to Fijians

|                              | Activity   | Completed   |
|------------------------------|--|-------------|
| Pre-Application              | ENG 1: Orientation to Engineering  | Fall 2012   |
|                              | ENG 2: Project Management  | Winter 2013 |
|                              | ENG 3: Research Skills   | Spring 2013 |
|                              | ENG 100A: Team Engineering   | Fall 2013   |
|                              | ENG 100L: Team Engineering Lab (Global TIES)                                     | Winter 2014 |
|                              | ENG 100B: Engineering Leadership   | Winter 2014 |
| GCSP Application             |  | Winter 2014 |
| Accepted as GC Scholar       |  | Spring 2014 |
| Component                    |  |             |
| Research/Project Activity    | ENG 100L: Team Engineering Lab   | Spring 2014 |
|                              | PRIME - Malaysia   | Summer 2014 |
|                              | GC Commitment Project  | Fall 2014   |
|                              | GC Commitment Project  | Winter 2015 |
|                              | GC Commitment Project  | Spring 2015 |
|                              | Team Internship – Solar Turbines   | Summer 2015 |
| Interdisciplinary Curriculum | Cognitive Science 10: Consequences of Technology                                 | Fall 2014   |
|                              | International Studies 101: Culture and Society in International Perspective (UD) | Winter 2015 |
|                              | Management 110:  | Spring 2015 |

|                                    |  |                       |
|------------------------------------|--|-----------------------|
|                                    | Business: Innovative Enterprise Creation and Management                          |                       |
|                                    | Management 166: Business Ethics and Corporate Responsibility (UD)                | Fall 2015             |
|                                    | Sociology 185: Globalization and Social Development (UD)                         | Winter 2016           |
| Entrepreneurship                   | Management 110: Business: Innovative Enterprise Creation and Management          | Spring 2015           |
|                                    | Moxie Center Workshop on Social Entrepreneurship                                 | Spring 2015           |
|                                    | Moxie Center Workshop on Patents and Patent Searching                            | Fall 2015             |
|                                    | Moxie Center Workshop on Startups  | Fall 2015             |
| Global Dimension                   | Global TIES  | Winter, Spring 2014   |
|                                    | PRIME - Malaysia   | Summer 2014           |
|                                    | International Studies 101: Culture and Society in International Perspective (UD) | Winter 2015           |
|                                    | Sociology 185: Globalization and Social Development (UD)                         | Winter 2016           |
|                                    | Independent Travel to Fiji   | Summer 2015           |
| Service Learning                   | Global TIES  | Winter, Spring 2014   |
|                                    | Alternative Spring Break - Philippines   | Spring 2015           |
|                                    | Engineers Without Borders – Student Chapter                                      | Fall 2014 - Present   |
|                                    | Engineers for a Sustainable World – Student Chapter                              | Winter 2015 - Present |
| GC Commitment Project              | Portable Solar-Powered Lantern   | Completed Spring 2015 |
| GC Capstone Paper and Presentation | One Lantern per Bure: Providing Affordable Lighting to Fijians                   | Completed Spring 2016 |

|                   |  |                     |
|-------------------|--|---------------------|
| GC Senior Seminar |  | Completed Fall 2015 |
|-------------------|--|---------------------|