

# Grand Challenge Scholars Program Proposal

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DREXEL UNIVERSITY  
College of  
Engineering

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National Academy of Engineering  
Grand Challenge Scholars Program Committee

Dear GCSP Committee Members,

I am extremely pleased that the Electrical and Computer Engineering Department of our college has taken the lead in initiating the formation of a Grand Challenge Scholars Program at Drexel and to provide the service of a member of the NAE to serve as its founding director. I am in full support of that initiative and trust, in time, other departments will join given the non-department/discipline specific nature with which the proposal has been written. While the program director will be supported through the department, my office will provide support for GCSP social functions as well as support for Scholars to attend a conference.

Sincerely,

A handwritten signature in black ink, appearing to read "J. Hughes", with a long horizontal line extending to the right.

Joseph B. Hughes, Ph.D., P.E., DEE  
Dean, College of Engineering  
University Distinguished Professor

# **Drexel University Electrical and Computer Engineering**

## **Grand Challenge Scholars Program**

### **VISION:**

Drexel's College of Engineering is in the beginning of its most recent Strategic Plan. Paraphrasing from aspects of that plan clearly identifies a direction in which the College has already identified itself with a number of the NAE Grand Challenges. Below we identify some of those aspects of the in-progress strategic plan of which the Electrical and Computer Engineering Dept. is an integral part and that establishes a framework in which our education and research programs are poised to address the Grand Challenges. Following that are examples of already established or planned actions which address the 5 key elements for Drexel's Grand Challenge Scholars Program and in which this department has a strong presence.

### **From the College's Current Strategic Plan:**

- Establish the College among the leading voices on energy and the environment in the nation to build broad public understanding of the scientific, public policy, financial, and political issues surrounding energy and the environment.
- Through expanded partnerships with the University's academic health sciences colleges and external healthcare institutions, the College will develop new technologies, systems, and processes to improve human health.
- Contribute to the development of a strong national cyber-infrastructure.
- Integrate the college's research agenda into all levels and years of engineering education. Introduce engineering students to other academic fields – such as policy studies, public health, design, and behavioral studies – that bear on each research area.
- Infuse engineering and technology education throughout the University to promote technological literacy.
- Incorporate international experiences into the college's curriculum, research, and Co-op experiences.
- The University is creating an "Innovation Neighborhood adjacent to our College of Engineering. This new "Innovation Neighborhood" will house interdisciplinary programs, innovation partnerships, industrial joint ventures, and incubators.

The electrical and computer engineering department faculty have been significant drivers of the elements in this plan. Joining with faculty colleagues from such areas as history and politics, philosophy, psychology, biodiversity, sociology, and entrepreneurship will establish the Grand Challenge Scholars environment. Faculty of the ECE department have taken the lead in educational innovations for many years impacting engineering education nationally and internationally. The E<sup>4</sup> program of the late 1980's and 1990's brought "engineering up-front" and served as a stimulus for what is now the norm in most schools of engineering. This was followed by the Gateway Engineering Education Coalition for more than a decade involving as many as 10 geographically dispersed institutions addressing, across institutional boundaries, not just content but also issues of delivery methods, the role of instructional technologies, professional development, under representation of women and minorities, and assessment. This was followed by a very successful GK-12 program and more recently the use of the NAE Grand

Challenge as a platform for K-12 outreach. Each of the above significant initiatives have been initiated, driven and led by faculty of Drexel's ECE Department. Thus it is within its culture and leadership that we expect to be a strong contributor to another undergraduate education initiative; the Grand Challenge Scholars Program.

**STUDENT SELECTION:**

Students must have a GPA of at least 3.25. They will complete an application form which will include a required essay of why the student wishes to be a part of the program. More specifically the student will be asked what s/he believes to be the benefit to them in their future career plans. Students will complete a proposed plan of study that satisfies the requirements of the GC Program and must identify a mentor who they will work with in meeting the GC objectives. S/he will also submit a letter of commitment from that mentor. This material will be submitted to the ECE/GCSP Director. The GC oversight committee will review all applications and make recommendations on admission. The ECE/GCSP expects to maintain approximately 10 students after a few years following activation. If a student were to change departments within the college they would be permitted to continue in the program if their new department and the mentor permit. Since the program is structured to be non-department/discipline specific, other departments within the college will be welcome to join and enable expansion. At such time one would expect the number of scholars to appropriately increase.

**PROGRAM STRUCTURE:**

Drexel engineering students participate in a 5 year Co-Op program of study structured in an academic quarter system. Curricular concepts of integration, design, and entrepreneurship begin as early as the freshman year. Thus the opportunities for students to address the objectives of the Grand Challenge Scholars Program exist beginning from the freshman year, throughout the 18 months of co-op experiences, and including the senior year at which time the students participate in an extensive full-year senior design program. The structure of the Drexel ECE undergraduate program with the components noted above and the co-op experiential periods, during which students may also take courses without additional cost, is a fertile environment for students to participate and complete the objectives of the GCSP. Students will be first introduced to the program in their first two quarters of their freshman year. They will have the opportunity to join the program anytime in the third quarter of their freshman year but not later than the end of their third year. Thus they will have between 2.3 and 4 years of participation in the GCSP. The leadership of the Drexel ECE Department has long recognized that one size does not fit all and thus has been taking steps to open the curriculum with elective course and research opportunities. This philosophy will prevail for the Grand Challenge Scholars. Each Scholar will develop an independent plan of study which will, while meeting all technical and general education curricular requirements, permit the student to select from curricular choices (within and external to engineering) as well as co-op and research opportunities to meet the objectives of a GCSP. The plan of study will be developed in concert with the GCSP Director. No student plan is cast in stone but is considered a dynamic blueprint and thus may be modified as interests evolve. When a GCSP student completes the program requirements and graduates they will receive a certificate of completion sign by both the NAE and the Drexel University official responsible.

## **MANAGEMENT AND ASSESSMENT:**

A member of the faculty committed to the defined objectives will serve as the Director of the GCSP. The Director will participate in the exchange of GCSP best practices, attend workshops, conferences with support of the Department and Dean, meetings, and prepare an annual report of programmatic accomplishments for the GCSP.

The administration and supervision of the program will be performed by an Oversight Committee comprising members of the ECE undergraduate and graduate curricular committees selected from within the College of Engineering, the Close School of Entrepreneurship, and appropriate departments from the College of Arts and Sciences who have expertise in such areas as international history and politics and ethics; societal consequences of technological innovation, and environmental impact. The Program Director, in consultation with the Head of the Dept. of Electrical and Computer Engineering, will select the members of the Oversight Committee. The GCSP Oversight Committee will be responsible for selection of student GCSP program participants, monitor their progress in concert with the GCSP director, and approve student's plans of study (and any revisions) to assure successful integration of the GCSP components. The GC Scholar must maintain at least a 3.0 GPA. The GCSP Director will compile the names and accomplishments of the GCSP Scholars, conduct longitudinal tracking of GCSP Scholars, and convey such information as part of the required annual report. This information will also be discussed by the GSP director with the assistant department head who is designated to certify a student's completion of degree requirements. If a student were to not complete the GCSP requirements then they would not receive the GCSP certification.

In most cases the GC Scholar's research will be part of the mentor's ongoing funded research program but, should it be needed to meet the specific needs of a GCSP scholar's work, an additional \$1,000 will be made available per GC Scholar by the ECE department for its Scholars. The daily operations will be supported by release time for the GCSP director and existing staff. In addition, the College of Engineering Dean's Office will provide support for social functions of the GC Scholars as well as support for the cost of travel, beyond what which the mentor can provide, to one conference per Scholar. Faculty will be invited to become mentors through departmental communications and Scholars will be provided with the results of that information. As part of the ongoing meetings and communications the GCSP director and staff support will discuss these choices with the Scholar. Mentors will be instructed on the GCSP requirements and, together with the GCSP director, will monitor/track student ongoing progress in meeting program objectives, adhering to their plan of study and GPA.

## **PROGRAM COMPONENTS:**

### **Addressing the five key elements of the Grand Challenge Scholars Curricular Program:**

- **Project or research activity connected to the Grand Challenges:**

The ECE department has many avenues through which the Grand Challenge Scholars will meet this objective.

- Annually the department has a full year senior design program in which student teams (this year there were 31 such teams) many of whom conduct research that can be linked to one or more of the grand challenges.
- The co-operative education model of the Drexel undergraduate program results in many opportunities for students to select industrial or research laboratory positions both nationally and internationally. There are campus based positions with campus faculty that are research focused. In fact, the University encourages such on-campus undergraduate co-op research linkages by offering financial support.
- The University has a web portal to which faculty post research opportunities for undergraduates during the academic year or summer. Again, a number of these may be linked to one or more of the grand challenges.
- The University has also established its STAR (Students Tackling Advanced Research) program which significantly supports students in the summer with stipend and housing. There is also an ISTAR (international opportunities) program of students doing research.

• **Interdisciplinary experience/curriculum beyond engineering:**

There is very little of engineering research that is not interdisciplinary whether within a faculty mentor's program or in a corporate co-op setting. However beyond that, and tying the GCSP scholar's curriculum within his/her specific disciplinary pursuits will be the requirement of using general education electives, free electives, and additional courses to provide breadth beyond engineering. Some of these curricular components may also satisfy the entrepreneurial or global perspective requirements. As will be noted at other points of this proposal, the 5 year co-op structure offers many opportunities during a student's industrial or academic research experience, national or international, to engage in and appreciate the interdisciplinarity of engineering as well as the world beyond engineering. Beyond the general education and free electives for which the curriculum is structured with time for such credits, a student may take, without additional cost, a course while on each of six co-op assignment quarters. Thus there is significant openness to the curriculum enabling students to not only take the minimum general education requirement but also for the entrepreneurial and global perspective courses. As noted earlier, each student will have a custom plan of study to be reviewed and approved by the GCSP Director.

Grand Challenge Scholars will take a minimum of 7 of the following 3 quarter credit general education courses. (PHIL 315- Engineering Ethics, is required)

Accounting (ACCT)	Dance (DANC)
Africana Studies (AFAS)	Economics (ECON)
Anthropology (ANTH)	Entertainment & Arts Management (EAM)
Architecture (ARCH)	Education (EDUC)
Art History (ARTH)	Entrepreneurship (ENTP)
Business Law (BLAW)	Film Studies (FMST)
General Business (BUSN)	Finance (FIN)
Communication (COM)	History (HIST)
Criminal Justice (CJ)	Hotel & Restaurant Management (HRM)
Culinary Arts (CULA)	Humanities (HUM, except 106,107,108)
Customer Operations (CUST)	International Area Studies (IAS)

International Business (INTB)  
Leadership (LEAD)  
Management (MGMT)  
Marketing (MKTG)  
Music (MUSC)  
Language (one of the following tracts)  
    Arabic (ARBC), Chinese (CHIN),  
    French (FREN), German (GER),  
    Greek (GREC), Italian (ITAL),  
    Japanese (JAPN), Korean(KOR), Russian(RUSS)  
Operations Management (OPM)  
Operations Research (OPR)  
Organizational Behavior (ORGB)  
Philosophy (PHIL)  
Photography (PHTO)  
Production Operations Management (POM)  
Political Science (PSCI)  
Psychology (PSY, except 330,337,364, 365)  
Screenwriting & Playwriting (SCRP)  
Sociology (SOC, except 364 & 365)  
Spanish (SPAN)  
Sports Management (SMT)  
Business Statistics (STAT)  
Taxation (TAX)  
Theatre (THTR)  
Women's Studies (WMST)  
Writing (WRIT)

- **Entrepreneurship and innovation experience:**

GCSP Scholars will take at least two of the following courses offered by the College of Business, the Close School of Entrepreneurship, and the Entrepreneurial Center. The GCSP Scholar may substitute or add courses from the Close School of Entrepreneurship's minors in Energy Innovations, Health Innovations, & Social Entrepreneurship with approval of the GCSP Director.

- Introduction to Entrepreneurship (MGMT 260)
- Business Plan for Entrepreneurs (MGMT 365)
- Leading Start-Ups (ENTP 210)
- Launch It!: Early Stage (ENTP 440)

- **Global and cross-cultural perspectives:**

The Grand Challenge Scholar will be asked to take at least one course from each of the following four categories:

- **General**

- Global Entrepreneurship (ENTP 370)
- Introduction to Global Engineering (ENGR 280)

- **International Business**

- International Business (INTB 200)
- International Business (BLAW 342)

- **Political Science/History**

- Introduction to Comparative Political Analysis (PSCI 140)
- Ethics and international relations (PSCI 352)
- The European Union (PSCI 357)

- **Culture and Communications**

- Culture and Values (IAS 359)
- International Communication (COM 360)
- Women and Society in a Global Context (WMST 214)

- **Service-learning and development of social consciousness:**

There will be multiple opportunities in which the GC Scholars will meet this objective. As a first step Drexel has for many years required every student to participate in a civic engagement course that includes field work. The course is designed to help students develop skills as active participants in a pluralistic, democratic society through direct service, education, and reflection opportunities. The course covers key concepts and frameworks for understanding civic engagement, including: models of civic life through America's history; critiques of philanthropy, volunteerism, community service, public service, and political activism; university-community relations; and public service leadership. Through the course, students strengthen critical thinking skills regarding a myriad of social issues in the context of active civic participation. Each student will complete between 8-10 hours of service with one community organization. Beyond this limited experience often the students will devote considerably more time especially if it becomes a part of an upper level project. In addition, through our EPICS (Engineering Projects In Community Service) partnerships as well as our freshman and senior design programs student teams, in collaboration with community groups and a faculty mentor, often assist in design, development, and fabrication of projects identified by and serve community needs. These opportunities are designed in partnership with nonprofit



organizations. In addition, some students may bring forth their own suggestions of community service projects ranging in time from the end of freshman year through senior year. In all cases the Scholar will be required to submit a written report on their activity and accomplishments to both themselves and the civic organization which they served. This service will become part of the ongoing discussions and assessment between the GCSP director and the Scholar in making determination to their sufficiency.