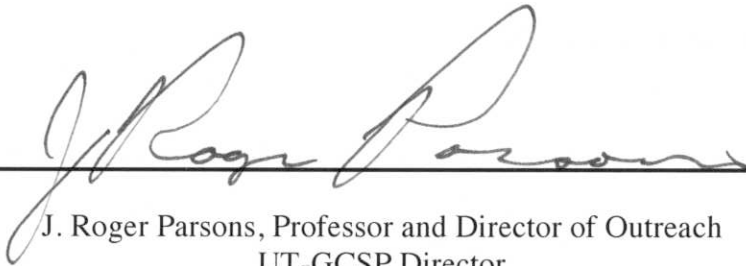


Proposal to Create
The Grand Challenge Scholars Program at the University of Tennessee



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The Grand Challenge Scholar at the University of Tennessee

There has never been a more exciting, yet challenging time to be in the field of engineering. Nothing exemplifies this more than the National Academy of Engineering's fourteen Grand Challenges that were published in 2008. These challenges are formidable and solutions will require that engineers work in a multidisciplinary way with other professions, as these challenges will require the engineering profession to work and interface with public policy, business, law, ethics, and social and human behavior. Our college, and its students, faculty and staff are engaged in a number of the Grand Challenges. Examples of the how our college's students and faculty are already engaging in the above components include involvement of our students in numerous research projects within the college; active involvement in international experiences (i.e. all honors and many other students in engineering will have had an international experience before graduating and there are now international COOP experiences); we recently developed UG minors in Leadership, Sustainability and in Engineering Entrepreneurship. As the increased demands on the undergraduate curriculum to educate the 21st century engineer have become apparent, we have sought innovative curricular solutions that provide additional student opportunities and increase the value of our degrees. We welcome the grand challenge of improving our curriculum to the high standards of the Grand Challenge Scholars Program.

Grand Challenge Scholar – Our Approach

At the UT College of Engineering, a curricular effort has been underway for the last two years to address the curricular demands of educating the 21st century engineer within the context of a large state university. This effort has focused on forming partnerships with other colleges and organizations in the university to offer coursework and experiences that are often beyond our expertise in the engineering college. These experiences provide the context and depth necessary to educate the well-rounded engineering leader necessary to approach the Grand Challenges.

This effort has culminated with the recent College and University approval of the Honors Engineering Leadership Minor (UT-HELM), an innovative partnership between the College of Engineering, UT Chancellors Honors Program (CHP), the College of Business, the Center for Entrepreneurship and Innovation, the College of Education, Health and Human Services, and Howard H. Baker Center for Public Policy. The objective of the Honors Engineering Leadership Minor is to help engineering students learn leadership, interpersonal, and communication skills necessary to apply their technical skills in real life situations. Through a combination of coursework and projects, students learn to develop their own leadership style and skills to become effective and influential engineers. The elements of the minor program are entrepreneurial basics, leadership and communication skill development, organizational and social psychology, service learning, and a capstone leadership experience. This minor is effective for the fall, 2010 semester. A description of the minor is included as an appendix to this document.

The objectives of UT-HELM and the Grand Challenge Scholars Program are closely aligned, both being driven by the same external forces. The University of Tennessee will base its Grand Challenge Scholars Program on UT- HELM, with additional requirements for students who wish

to pursue this additional certification and recognition. The principal additional requirement will be for a Grand Challenge undergraduate research project, along with curricular connectivity requirements. The organizational and assessment structure will be an extension of that put in place to manage UT-HELM.

Our Grand Challenge scholars will be pursuing university honors degrees, plus the UT-HELM minor, plus a Grand Challenge research experience.

Student Selection

Initial selection for UT-HELM and GCSP will be through admission to the UT Chancellors Honors program. Most students are admitted to this program as incoming freshmen but successful undergraduates can apply for admission later in their undergraduate career. Admission to this university honors program is more holistic than general admission to the university, with essays, recommendations, service and extracurricular activities being given more weight than for general admission students. The College of Engineering typically receives 25% of the incoming Chancellors Honors students, although we represent only 12% of the incoming university class as a whole. These approximately 60 incoming Chancellors Honors/Engineering students per year represent the top 10-12% of our incoming engineering class and will be the basic recruiting class for the UT-HELM and the GCSP programs. The Chancellor's Honors class is chosen with a commitment to diversity. Our entering engineering honors class is consistently one-third women, while our general entering class is 18% female.

Students will join UT-HELM/GCSP by application as early as the spring of their first year at UT. We expect 10-15 students a year to join the program. After acceptance of the application by the GCSP steering committee, an initial curricular plan will be developed by the student in conjunction with the UT-HELM/GCSP advisor and the professional advising staff of the College. This plan will be updated and submitted by the student to the advisor once a year. The student must maintain a 3.25 minimum GPA to continue in this honors program.

Curriculum Sequence

We consider the education of a Grand Challenge scholar a four-year integrated experience. The nominal sequence of curricular and extra-curricular experiences will be:

First year

The introduction for all engineering honors students –

EF 157, EF 158 – These courses are an 8-semester hour engineering fundamentals sequence for honors freshmen. They combine mechanics physics content with perspective of the engineering profession, team dynamics, the design method, and extensive team projects. Since the start of the Grand Challenges program, the final project of the spring semester has been Grand Challenge themed. Our objective is have these talented students realize that, although they have just begun

their engineering studies, the engineering design method and team problem solving gives them powerful tools to approach very complex problems.

UH 100 Seminar – Small (15 students maximum) seminars. All seminars are interdisciplinary by design. Required for all honors students. Two engineering themed seminars are taught each year, specifically:

Engineering the Twentieth Century: Exploring the Foundations of the Modern World

Course Description: In this course, we explore some of the engineering achievements that occurred in the late nineteenth and early twentieth centuries in the areas of communications, transportation, construction, and power distribution that laid the foundation for our modern technological based society. The historical and technological context of these breakthroughs and their impact on society is investigated.

When Things Go Wrong, Engineering Disasters and Lessons Learned Course Description:

In this course we discuss personal risk, societal risk, and the interaction of society with engineered devices. We look at well-known engineering failures as case studies and see what we have learned (or not) from these experiences.

Interested students then apply for the UT-HELM minor/GCSP extension during the spring of their first year. This is the same application for both programs and the two programs run in parallel until GCSP students pick a research topic and mentor.

First UT-HELM/GCSP advising session held with GCSP advisor to establish tentative plan for fulfilling curricular and connectivity requirements. Curricular plan of study filed with GCSP advisor.

Second year

UT-HELM/GCSP students pursue engineering ethics, service learning, and interdisciplinary coursework and experiences.

Study abroad experiences are recommended for either second or third year, including summer term.

Update plan of study with GCSP advisor.

Third year

Students pursue Leadership and Entrepreneurship coursework. Students begin extra-curricular requirements for minor.

Update plan of study with GCSP advisor, pick research mentor in consultation with GCSP advisor.

Fourth year

GCSP students pursue undergraduate research experience in Grand Challenge area with presentation of results.

Students complete elective course requirements for HELM minor.

Students complete extra-curricular requirements of HELM minor.

Students prepare “Application for Grand Challenge Certification” for approval by GCSP advisor.

The Five Grand Challenge Scholar Curricular Components

(The overlaps with Chancellors Honors Program and UT-HELM requirements are noted.)

1) Research Experience

Student can fulfill this requirement by:

- a) Completion of a semester-long (minimum) undergraduate research experience with a UT faculty member in his/her laboratory, with a Grand Challenge theme. This experience will be arranged under the rules for engineering independent study courses, that is, a written scope of work document is prepared at the beginning of the project and agreed to by both the student and research mentor. Normally the student will receive technical elective course credit for this work, although the GCSP advisor can approve alternative arrangements that are acceptable to both the student and research mentor. The GCSP advisor will assist the student in making arrangements for the research experience. This experience must result in a mentor approved paper or poster, and student presented results, either at EURECA (Exhibition of Undergraduate Research and Creative Achievement, UT’s annual poster competition for undergraduate research), UT Honors Symposium, or other professional presentation format approved by GCSP advisor.
- b) Or, completion of an independent design or entrepreneurship project with a Grand Challenge theme. Project must have a mentor who is a UT professor. As above, a mentor approved paper or poster is the end result, and professional presentation of results is expected. In this case, the GCSP advisor must also approve the subject of the project and presentation format.

2) Interdisciplinary Curriculum

GCSP Students will fulfill this requirement by taking a minimum of 10 credit hours of coursework from two areas, a) interdisciplinary honors courses, and b) those interdisciplinary courses offered as part of the UT-HELM minor. The selection of these courses will be part of the students curricular connectivity plan decided on in conjunction with the GCSP advisor. In category a), students will take a UH 100 seminar (1 credit hour, described above), and at least one other course from the available list (4 credit hours total) described below. These interdisciplinary honors courses count towards the 25 credit hour honors course requirement for

an honors degree. In category b), the minimum requirement is 6 credit hours, and these courses count towards the students UT-HELM minor.

a) Interdisciplinary Honors Courses

The Chancellors Honors program offers UT faculty the opportunity to propose interdisciplinary coursework to be taught to the honors students. These courses are listed as UH (University Honors) and must emphasize the intersection of multiple study areas. Engineering honors students count these courses as part of the general education requirements for their degree. CHP students are required to take 25 hours of honors coursework for their honors degree, which may come from these interdisciplinary offerings, or departmental honors offerings.

UH offerings change each year, a list of those currently available at <http://honors.utk.edu/honorscourses/uhcourses.html>

Among those currently available are:

UH 267 Science and Revolution, Section 006, 3 Credits

This course will explore two related questions: (1) how does change in science occur? and (2) How do changes in science affect the broader society? After reading Thomas Kuhn's classic book, *The Structure of Scientific Revolutions*, we will study several important incidents in the history of science: the so-called scientific revolution, the so-called chemical revolution, Darwin and the theory of evolution and, if time permits, the origins of 20th century science (relativity and quantum mechanics).

UH 357 Computing in Society: Use and Misuse, Section 001, 3 Credits

Survey and analysis of the impact of computers and technology on society. No prior computer/computing experience needed; course will provide an overview of the computer science concepts needed to understand everyday computer applications (e.g. Mapquest, Google, spam) and analyze social issues raised by computing (e.g. electronic voting, Wikipedia vs. truth, online privacy, and technological unemployment).

b) Interdisciplinary Coursework offered through UT-HELM

EF 337 Developing Leadership Skills (Management 331 with honors activities) This course is required for UT-HELM. Focuses on developing leadership skills. Provides students with self-assessment, developmental exercises, and case studies to prepare them for leadership roles.

Philosophy 241 Engineering Ethics This course is co-taught by Philosophy and Engineering and is optional for UT-HELM. Ethical issues in engineering at the intersection of science, business, and society. Topics such as international concerns; risk, safety, and the environment; employee loyalties and professional responsibility; and professional organizations and codes of conduct.

Psychology 440 Organizational Psychology This course is optional for UT-HELM. Social Psychological analysis of organizations emphasizing role theory and systems theory.

Communications Studies 440 Organizational Communications This course is optional for UT-HELM. Organizational setting and those variables of the communication process that affect the quality of human interaction both within and outside the organization.

3) Entrepreneurship

Requirement will be fulfilled by taking:

EF 357 Introduction to Entrepreneurship (Management 350 with honors activities) This course is required for UT-HELM. An introduction to entrepreneurship with an emphasis on identifying, evaluating and developing new venture opportunities. Topics include opportunity identification and evaluation, start-up strategies, business valuation, business plan development, attracting stakeholders, financing the venture, managing the growing business and exit strategies.

Student may also take:

Management 451 – New Venture Planning (optional for UT-HELM) Integration of various functional disciplines and their application to general management of new ventures within established companies and entrepreneurial enterprises. Focuses on the components necessary for the development of a business plan.

Management 460 – Leading Innovation and Change (optional for UT-HELM) This course covers how managers identify and nurture new business opportunities while maintaining competitive advantage. Topics include examination of change models, the role of middle managers in large organizations, and ways to address resistance to change.

4) Global Dimension

As a requirement for their honors degree, students must complete an approved international or intercultural experience. In most cases this is a study abroad experience, but international internships, and in some cases, coursework and accompanying project with intercultural content is acceptable to the honors program. Because an international experience is a critical element of becoming a Grand Challenge Scholar, the students international experience plan must be a part of their GCSP plan of study and approved by the GCSP advisor. The GCSP advisor will not approve plans that do not involve international travel and engagement with a different culture.

5) Service Learning

Requirement will be fulfilled by taking UH 267. This course is required for UT-HELM. This course is a component of a partnership between the College of Education and the Howard H. Baker Center for Public Policy to promote the full service school concept to currently underserved schools in the Knoxville area. Students combine classroom work on the concepts and traditions of service learning with conducting independent projects in local elementary schools.

UH 267 Service Learning, 3 Credits

This class will immerse you in a local community to provide you with a new way of learning through service. Success in any field requires not only knowledge of your discipline but skill in taking initiative and fostering interconnectedness with peers and the community. This class builds specifically on this basis by emphasizing the mutual benefits of service for both the community and the students. Components of this course will include weekly journals, weekly service activities in local underserved schools, interdisciplinary discussions and speakers, and creative, self-designed projects.

As an alternative, students may petition an alternate service learning experience to the UT GCSP Steering Committee.

Extra-Curricular Components

In addition to the curricular components discussed above, UT-HELM requires students in this minor to demonstrate leadership by assuming leadership positions in the College and University. This requirement has two parts:

- a) Contribute service to the College or University through holding a selected or elected leadership position. Examples of acceptable positions are College Ambassador, Co-op Ambassador, Officer of student technical society, Orientation Leader, Resident Assistant for Engage engineering residential community, or other positions approved by minor advisor.
- b) And, demonstrate technical project leadership, normally by a) serving as team leader for senior design or other departmental project course, or b) competing in the College of Business' Business Plan competition to commercialize a new product. The minor advisor could approve other experiences for this requirement.

Summary of Grand Challenge Scholar Curricular Requirements

GCSP students will complete their honors degrees through the Chancellors Honors Program. This requires no additional credit hours but requires a) selection for the CHP, b) maintaining a 3.25 minimum GPA, completion of 25 hours of honors designated coursework (including honors specific interdisciplinary coursework) within the Bachelor's degree program, and d) completion of an international or intercultural experience.

And, they will complete the Honors Engineering Leadership Minor (UT-HELM). This minor requires 18 additional hours to the Bachelor's degree program, plus non-credit capstone service and leadership activities. Some coursework could double-count as general education electives or technical electives at the discretion of the students home department. This minor adds service learning, entrepreneurship, and interdisciplinary leadership curricular components.

And, they will complete a research experience with a Grand Challenge theme.

Students could complete all requirements of the Grand Challenge Scholar Program and qualify for national certification with one additional semester.

Administration and Assessment

UT GCSP Steering Committee

The University of Tennessee Grand Challenge Scholars Program will operate under the guidance of a steering committee. This steering committee will have three permanent members, the College of Engineering Director of Outreach, the COE Director of College Honors, and the Associate Dean of Student and Academic Affairs. Two other members will be appointed to serve two-year terms, and will be chosen from COE or College of Business entrepreneurship faculty. The Director of the Chancellors Honors Program will be kept apprised of all actions of the steering committee.

The steering committee will be responsible for admitting students into the program, setting operating policies, evaluating overall progress of the program, and implementing changes when needed.

GCSP Director

The COE Director of Outreach will operate as the GCSP Director and principal student advisor. He will coordinate the application process; initial advising and planning sessions, and yearly plan updates. He has the responsibility of ensuring thematic continuity and connectivity in the student plans. He will have the power to approve student requested modification of requirements or course substitutions. He will bring the request before the steering committee if he feels the request amounts to a policy change that can affect multiple students.

The Program Director will compile the names and accomplishments of the graduating GC Scholars for an annual report to the national steering committee. He, or other members of the UT GCSP steering committee, will regularly participate in GCSP workshops.

GCSP Students

Students in this program are expected to act independently, know all requirements of the program, and bring problems to the attention of the GCSP director promptly. They have the responsibility of choosing their interdisciplinary and optional coursework wisely, proposing a plan that has thematic continuity and connectivity. A yearly plan update meeting with the Director is required.

A narrative “Application for Grand Challenge Scholar Certification” is required at the end of the program that summarizes how the requirements were met, including any substitutions that were requested and approved, and a reflection on the total GCSP program both from the perspective of what the student felt they gained from the experience, and how the program could be improved. A professional resume must be included with the application for certification.

Reference Websites for More Information on Program Components

The University of Tennessee College of Engineering, <http://www.engr.utk.edu/>

UT-COE Outreach office, <http://www.engr.utk.edu/outreach/>

Honors Freshmen Engineering Program,
<http://volmoodle.net/>

Honors Program Partner, the Chancellors Honors Program,
<http://honors.utk.edu/>

Entrepreneurship Partner, The College of Business Center for Entrepreneurship and Innovation,
<http://cei.utk.edu/>

Service Learning Partner, the Baker Center, <http://bakercenter.utk.edu/main/index.php> and a description of the university assisted community school model
<http://bakercenter.utk.edu/main/announcement.php?key=86>

Global Dimension Partner, the UT Center for International Education,
<https://studyabroad.utk.edu/>

Undergraduate Presentation Opportunities, EURCA, <http://research.utk.edu/eurca/> and Honors Symposium,
<http://honors.utk.edu/frontpage/features/honorssymposium/honorssymposium2010.html>

Appendix A - A roadmap for students interested in the Grand Challenge Scholars Program

“These are no ordinary times... the 21st century is very different than the 20th century, and brings with it enormous challenges.”

– Charles Vest, President of the National Academy of Engineering

“ Because engineering inevitably means intervening in the world, all engineering projects carry with them responsibility for the effects of those interventions. Students need powerful learning opportunities... to recognize that they will always need to know much more than they do, and that social and ethical connections are at least as important as electrical and mechanical ones.”

- The Carnegie Foundation for the Advancement of Teaching, in Educating Engineers: Designing the Future of the Field

Are you preparing yourself for these challenges? The College of Engineering is pleased to announce a special opportunity for its honors students, the Grand Challenge Scholar Program (GCSP). Our goal is to prepare the leaders who can be productive contributors working on the Grand Challenges of the new century

(<http://www.engineeringchallenges.org/>) This program will work in conjunction with the

new Honors Engineering Leadership Minor (HELM) and partnerships with other Colleges and Centers at the university to provide a select group of students with experiential coursework emphasizing the context of engineering solutions in the world. It will provide you with an introduction to research in the grand challenges.

At the completion of this intensive program you will have a) a UT honors degree in the engineering curriculum of your choice, b) a leadership minor (Honors Engineering leadership Minor, or HELM), and c) a certificate as a Grand Challenge Scholar, a national certificate program administered by the National Academy of Engineering. Completion of this program adds the 18 additional semester hours of the HELM minor to your degree program requirements, although some courses can be double counted for all majors and others can be double counted at the discretion of individual departments.

Each student's program will be individually arranged in conjunction with a GCSP advisor, but the expected sequence of curricular and extra-curricular experiences will be:

First year

The introduction to grand challenge themes for all engineering honors students –

EF 157, EF 158 – These courses are an 8-semester hour engineering fundamentals sequence for honors freshmen. They combine mechanics physics content with perspective of the engineering profession, team dynamics, the design method, and extensive team projects. Since the start of the Grand Challenges program, the final project of the spring semester has been Grand Challenge themed.

UH 100 Seminar – Small (15 students maximum) seminars. All seminars are interdisciplinary by design. Required for all honors students. Two engineering themed seminars are taught each year.

Interested students then apply for the UT-HELM minor/GCSP extension during the spring of their first year. This is the same application for both programs and the two programs run in parallel until GCSP students pick a research topic and mentor.

First UT-HELM/GCSP advising session held with GCSP advisor to establish tentative plan for fulfilling curricular and connectivity requirements. Curricular plan of study filed with GCSP advisor.

Second year

UT-HELM/GCSP students pursue engineering ethics, service learning, and interdisciplinary coursework and experiences.

Recommended:

UH 267 Service Learning

Philosophy 241 Engineering Ethics

One additional UH 200-300 interdisciplinary course

Study abroad experiences are recommended for either second or third year, including summer term.

Update plan of study with GCSP advisor.

Third year

Students pursue Leadership and Entrepreneurship coursework. Students begin extra-curricular requirements for minor.

Recommended:

EF 337 Developing Leadership Skills

EF 357 Introduction to Entrepreneurship

Update plan of study with GCSP advisor, pick research mentor in consultation with GCSP advisor.

Fourth year

GCSP students pursue undergraduate research experience in Grand Challenge area with presentation of results. In most departments, this will count towards your degree as a technical elective.

Students complete elective course requirements for HELM minor.

Students complete extra-curricular requirements of HELM minor.

Students prepare “Application for Grand Challenge Certification” for approval by GSCP advisor.

Appendix B – Summary: Honors Engineering Leadership Minor (HELM)

(For students in the Chancellor’s Honors Program, Haslam Scholars, or a departmental honors program in the College of Engineering)

The objective of the Honors Engineering Leadership Minor is to help engineering students learn leadership, interpersonal, and communication skills necessary to apply their technical skills in real life situations. Through a combination of coursework and projects, students will learn to develop their own leadership style and skills to become effective and influential engineers. The elements of the minor program are entrepreneurial basics, leadership and communication skill development, organizational and social psychology, service learning, and a capstone leadership experience.

a) Required courses

- EF 337 Developing Leadership Skills (Management 331 with honors activities)
- EF 357 Introduction to Entrepreneurship (Management 350 with honors activities)

- UH 267/347 Honors concentration in Social Sciences, Service Learning

b) Elective courses – Students would take three of the following five courses:

- Philosophy 241 - Engineering Ethics
- Management 451 – New Venture Planning
- Management 460 – Leading Innovation and Change
- Psychology 440 – Organizational Psychology
- Communication Studies 440 - Organizational Communications

c) College leadership capstone – Students in this minor are expected to demonstrate leadership by assuming leadership positions in the College and University. This requirement has two parts:

- Contribute service to the College or University through holding a selected or elected leadership position. Examples of acceptable positions are College Ambassador, Co-op Ambassador, Officer of student technical society, Orientation Leader, Resident Assistant for Engage residential community, or other positions approved by minor advisor.
- Demonstrate technical project leadership, normally by a) serving as team leader for senior design or other departmental project course, or b) competing in the College of Business' Business Plan competition to commercialize a new product. The minor advisor could approve other experiences for this requirement.

Minor requires 18 hours, plus non-credit capstone service and leadership activities.