# Proposal to establish a

# Grand Challenge Scholars Program (GCSP)

# at Lawrence Technological University

Revised 09/18 Submission

April 25, 2019

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1.  **Vision and Goals**

   The Grand Challenge Scholars Program (GCSP) offers Lawrence Technological University (LTU) an opportunity to advance the primary goal identified in LTU's 2016 Strategic Plan: to "become a national leader in STEM and design education, global awareness, and undergraduate research embracing theory and practice." The Strategic Plan places particular emphasis upon "research projects stimulating cross-disciplinary inquiry, and encouraging underrepresented minorities and female students to enter the STEM disciplines."  LTU's GCSP steering committee has adopted the Teagle Foundation mission to develop "liberal-arts infused" GCSPs as an opportunity to forge new interdisciplinary partnerships among LTU's College of Arts & Sciences and College of Engineering faculty and students.

   A new GCSP aligns well with several long-term initiatives already underway in each of these colleges. For a decade, LTU's College of Engineering has been a flagship school in the Kern Entrepreneurial Engineering Education Network (KEEN). The pedagogical and curricular reforms adopted to advance those partnerships align very closely with the National Academy of Engineering's program competencies for GCSP. LTU's College of Arts & Sciences is several years into developing its CURE curriculum, emphasizing Course-based Undergraduate Research Experiences particularly in first- and second- year courses.

   LTU's GCSP will draw upon these existing strengths to create new opportunities for Engineering and Arts & Sciences students to collaborate and develop the skills required to successfully engage the Grand Challenges of the 21$^{st}$ century. Implementing a GCSP will help ensure all GC Scholars achieve a broad interdisciplinarity education and increased community and social engagement needed to be equipped to help solve Grand Challenges of the 21st Century.

## 2. Program Competencies

Upon completion of the GCSP, LTU students will have demonstrated an ability to:

*Research / creative*
1. Design and execute a research project that advances understanding of one or more of the NAE Grand Challenges

*Multidisciplinary*
2. Collaborate in multidisciplinary teams
3. Evaluate technological or natural-scientific problems with humanistic or social-scientific methodologies, and develop multidisciplinary solutions

*Business / entrepreneurship*
4. Develop ideas into innovations, and translate inventions into market ventures
5. Evaluate the economic dimensions of technical problems

*Multicultural*
6. Collaborate in multicultural teams
7. Evaluate technical problems from diverse cultural perspectives

*Social consciousness*
8. Evaluate the social consequences of technological change, and the ethical responsibilities of engineers and scientists


The GCSP Competencies align with University and college student learning outcomes, and with ongoing pedagogical and curricular innovation initiatives. The College of Engineering's KEEN certifications have involved extensive faculty training, in both CoE and CoAS, in Active Collaborative Learning (ACL), Problem Based Learning (PBL), and Entrepreneurial Minded Learning (EML) teaching methodologies. Leadership and professional ethics have also constituted a principal focus of the KEEN initiatives. The College of Arts and Sciences' CURE Program has focused on research and teaching collaborations between STEM and liberal arts faculty. Recently supported by a Howard Hughes Medical Institute grant dedicated to increasing cultural diversity in the STEM fields, the CURE Program has become an instrument for the University's K-12 STEM outreach in Metro Detroit. These initiatives are among the most prominent of an array of University initiatives to support multidisciplinary research, entrepreneurship, leadership, ethics and global awareness. The GCSP competencies thus describe core University values embedded across the curriculum.

This section of the proposal focuses on the courses and programmatic experiences constituting the core requirements of LTU's GCSP. These requirements are necessarily tied to University or college course requirements. GCSP students will find these

competencies reinforced and developed across their LTU experience, and in particular in advanced courses within their majors too diverse to categorize here. The primary GCSP course requirements are illustrated below:

| CoE GCSP Courses | GCSP Core Requirements | CoAS GCSP Courses |
|---|---|---|
| EGE1001: Intro to Engineering<br>EGE2233: Entrep Mindset<br>EGE3022: Leadership / Prof Development | Humanities Core:<br>• LLT1213/LLT1223 World Masterpieces 1 & 2 (literature survey) 1 GCSP section required<br>• SSC2413/SSC2423 Foundations & Development Am Exp (philosophy survey) 1 GCSP section required<br>• Jr/Sr Humanities Elective: GCSP research seminar<br><br>EGE2123: Entrepreneurial Design Studio<br><br>Blue Devil Ambassadors service learning program<br><br>GCSP research project: eg. capstone / senior project / thesis course or competition team | COM1001: Pathways to Research Careers<br>COM4001: Pathways Capstone |

Each of the 'Core Requirements' targets one of more of the GCSP competencies, and is supported by a constellation of courses within each college and major program. Grand Challenge Scholars will validate each of their competencies by completing a discrete requirement.

| Research | • Capstone / Senior Projects / Thesis course (varies by major)<br>or<br>• Competition / research team |
|---|---|
| Multidisciplinarity | • GCSP Humanities research seminar |
| Entrepreneurship | • EGE2123 Entrepreneurial Design Studio |
| Multiculturalism | • GCSP sections (2) of liberal arts Core Curriculum (LLT1213/1223; SSC2423/2413) |
| Social Consciousness | • Blue Devil Ambassadors |

## a. Research/Creativity

LTU GCSP students will be required to engage in a research or design experience advancing understanding of one of the National Academy of Engineering's Grand Challenges:

| | |
|---|---|
| 1. Provide energy from fusion | 8. Engineering better medicines |
| 2. Make solar energy economical | 9. Enhance virtual reality |
| 3. Manage the nitrogen cycle | 10. Secure cyberspace |
| 4. Improve urban infrastructure | 11. Reverse-engineer the brain |
| 5. Develop carbon sequestration | 12. Advance health informatics |
| 6. Access to clean drinking water | 13. Advance personalized learning |
| 7. Prevent nuclear terror | 14. Tools of scientific discovery |

LTU students currently have an array of opportunities to participate in design and research projects related to the Grand Challenges. These opportunities are most commonly presented in students' capstone / thesis / senior projects courses (depending on major), or through competition teams. Several other programs, such as QUEST, REU Summer Experience, and research assistantships, also support students in advanced co- or extra-curricular research projects.

For example, capstone projects within the Department of Civil Engineering regularly address the restoration and improvement of urban infrastructure within the metro Detroit area. Civil Engineering students are involved in projects related to the effects of low impact development, designing for public safety, and remediation and rehabilitation of contaminated sites for public use. Architectural Engineering students are involved in capstone projects related to solar energy and sustainability. The Biomedical Engineering Department conducts research related to ligament tissue engineering and microscope design for tracking cell behavior, as well as many other health related topics.

In the College of Arts & Sciences, students' research aspirations are focused upon the Grand Challenges from the first semester, in COM1001: Pathways to Research Careers. Every student completes a research poster that develops a hypothesis about the impact of a technical development in their field upon one of the Grand Challenges. Advanced CoAS students engage in a variety of Grand Challenge-related research. Molecular and Cellular Biology students are researching pharmaceuticals designed to operate on specific genetic profiles. Computer Science and Physics students are collaborating on data-mining Hubble Space Telescope images to establish typologies in Astrophysics. Psychology students are using Virtual Reality simulations of automobile dashboards to research human sense and perception in digital environments.

Much of the advanced design and research work that LTU students are currently doing will qualify as GCSP-related. In their GCSP application, students will identify a GC-related research or design experience, the program or course that will provide this experience and their faculty advisor. Extra-curricular experiences (such as participation on a competition team) require pre-approval from the GCSP Oversight Board to ensure the experience approximates the duration, depth and intensity of a project embedded in a three

credit hour course. Once completed, the GC Scholar will submit a report, endorsed by the program supervisor or supervising faculty member, to the GCSP Co-Directors or Oversight Committee for review and final approval.

The GCSP is an opportunity for the program's oversight board to cultivate additional research projects addressing the Grand Challenges, with special emphasis upon those that emphasize a) inter- departmental or college collaboration, or b) humanistic or social-science approaches to technical problems. Multidisciplinary approaches to technological problems is the LTU GCSP's core "brand".

## b. Multidisciplinarity

As described by the NAE's GCSP guidelines, LTU GCSP students will be required to complete a curriculum that enables them to work at the boundary between engineering and non-engineering disciplines. At LTU this interdisciplinary curriculum will include GCSP designated sections of Core Curriculum liberal arts requirements and upper level humanities electives as well as LTU's unique entrepreneurial engineering design studio course (EGE 2123).

First, LTU's liberal arts Core Curriculum centers upon the following two-semester, "great books" course series:

> LLT1213: World Masterpieces 1
> LLT1223: World Masterpieces 2
> SSC2413: Foundations of American Experience
> SSC2423: Development American Experience

Grand Challenge sections of each of these courses are designated in the course schedule and available to all LTU students. GCSP students must complete Grand Challenge sections in two of these four courses. Faculty offering Grand Challenge sections will include texts and discussion exercises that allow students to probe historical and contemporary cultural issues pertaining to sustainability, globalization, technological progress, and ethical practices in engineering, science, and medicine. Course writing assignments will be tailored to engage the Grand Challenge problems in ways that encourage students to draw on discipline-specific knowledge garnered in courses in engineering and the natural sciences.

Secondly, LTU offers a unique sophomore level design course called EGE 2123 - Entrepreneurial Engineering Design Studio. EGE2123 is currently required for most Engineering majors. This team-based studio was developed as one foundational component of the College of Engineering's broad initiative to lead the KEEN network in Entrepreneurial Minded Learning (EML) pedagogy. All GCSP students will be required to take EGE 2123, including GC Scholars from the College of Arts & Sciences. LTU's GCSP

requirement that Arts & Sciences majors take this Engineering course represents a substantial, and unprecedented at LTU, commitment to interdisciplinarity.

In EGE2123, students identify opportunities for engineering design, engage real customers outside of the classroom, and build working prototypes that create value for these customers. Essentially, they engage in an entrepreneurial design experience over the course of the semester as they address social needs within market parameters. Design themes such as "Accessibility in the Workplace" and "Accessibility in Sports" connects students with local non-profit agencies and charges them with designing and building prototypes that will help people with disabilities in the workplace or in recreational sports such as kayaking and snow skiing. Having all GC Scholars from disciplines within Engineering and Arts & Sciences solving problems and working on these design teams together will provide varied perspectives and a rich, interdisciplinary design studio experience. Indeed, these are the types of interdisciplinary teams that will be required to solve the Grand Challenges of the 21st century.

Finally, all LTU undergraduates complete an upper-level Humanities elective in their last two years. HSSC offers a wide variety of electives, from Shakespeare and Modernist Poetry to Constitutional Law and Ancient History. The GCSP oversight committee will designate specific elective courses as "Grand Challenge" courses that either focus broadly on technological or design themes, or have been developed specifically to support an ongoing GCSP research project on campus. Several courses in the current roster of electives align with LTU's interdisciplinary GCSP competency. For example, LLT3623: Literature and Science, and SSC4733: History of Technology, set broad themes that diverse faculty can interpret through their own research backgrounds. Courses such as LLT6013: Literature of the Built Environment, and SSC3363: Philosophy, Society and Energy, engage more narrowly defined STEM topics. SSC4513: The Geopolitics of Natural Resources was developed in response to specific requests by Engineering faculty for a Humanities elective that exposed their students to social-science methodologies for understanding energy-resource challenges.

Analogous to the "Grand Challenge" sections of the liberal arts Core Curriculum courses, the "Grand Challenge" electives will be required of, but not exclusive to, GCSP students. All LTU students will be able take these courses to satisfy their common graduation requirement, further disseminating the GCSP's curricular impact.

### c. Entrepreneurship

Prominent in LTU's strategic vision is its mission to be "recognized for transformative STEM and Design education that develops leaders with an entrepreneurial mindset and global perspective." The KEEN network has placed a strong emphasis upon instilling an entrepreneurial mindset in students, and LTU's engineering faculty have been in the vanguard developing Entrepreneurial Minded Learning (EML) pedagogies. The campus-wide effort at LTU to foster an entrepreneurial mindset in our graduates is focused on three areas: faculty engagement, curriculum development, and student engagement.

These efforts have produced a culture rich with opportunities for our GCSP students to fulfill competency.

A continuous thread of entrepreneurially minded learning is woven through the core engineering curriculum. GCSP students in the College of Engineering will complete a series of three courses within this thread. In the freshman year, the foundation of entrepreneurial mindset is developed in the required EGE 1001 Introduction to Engineering Design Projects. EGE 1001 is an active and engaging course that demonstrates the many aspects of engineering, the engineer's role in society, and the entrepreneurial mindset. In addition, this course contains an introduction to the NAE's Grand Challenges, several active learning modules related to the Grand Challenges, and a writing assignment around students' particular passions for specific Grand Challenges.

In the sophomore year, as mentioned previously, engineering students take EGE 2123: Entrepreneurial Engineering Design Studio and build upon the foundation of entrepreneurial mindset development laid in the introductory design course. They identify design and business opportunities within a theme, engage real customers beyond the walls of the classroom, and create a working prototype that creates value for these customers. In addition, students perform market and patent research, economic analysis, and several project pitches in this particular course.

In the junior year, engineering students take EGE 3022: Leadership and Professional Development for Engineers to further develop their entrepreneurial mindset with regard to leadership, teamwork, ethics, and professional development. Throughout the curriculum, professional skills such as oral and written communication, innovation, understanding constraints, sustainability, technical feasibility, customer value, societal benefits, economic analysis, and professional ethics are addressed with increasing depth as students develop their entrepreneurial mindset.

LTU's GCSP requirement that CoAS students complete EGE2123 constitutes the sole 'additional credit hours' mandated anywhere in the program. This requirement is an acknowledgement of the sophistication of CoE's EML curriculum, and an optimal place for CoAS students to build upon a comparatively under-developed EML curriculum in CoAS. CoAS's Pathways to Research Careers Program, launched in 2017-18 with the support of the Teagle Foundation, is the primary vehicle for the college's entrepreneurship initiatives.

COM1001: Pathways to Research Careers gives students an opportunity to chart a path from their major program to their professional career. It is ideally situated to develop entrepreneurial mindedness. Students are required to include an economic / marketing dimension in their Grand Challenge research project posters, the primary semester assignment. Field trips to the urban innovation hub Detroit Tech-Town, and campus events organized around guest speakers from the U.S. Patent Office and a venture capital firm Medical Innovations, were featured events of the fall 2017 launch of COM1001. Additional events and collaborations with CoE entrepreneurship groups (MPower) are planned for 2018-19.

COM4001: Pathways Capstone is still in development, slated for launch in fall 2019. The primary focus of COM4001 is requiring students to develop a post-graduation plan: job market, graduate school, business start-ups, public service, etc. It too is intrinsically entrepreneurial in its orientation, and will be ideally suited to further elaborate the EML methodologies CoAS GCSP students encounter in EGE2123.

While the overall tone of LTU's GCSP proposal emphasizes (consistent with its Teagle mandate) infusing and adapting liberal arts elements to STEM curriculum, entrepreneurship is a competency where there is enormous potential for a traditional strength of our CoE to cross-pollinate and strengthen a traditional weakness of our CoAS. CoAS's GCSP students will serve as entrepreneurial leaders for their Arts & Science peers.

### d. Multicultural

The liberal arts Core Curriculum and Jr/Sr Humanities electives are the primary places in the curriculum where LTU students are exposed to cultural studies as a research methodology. World Masterpieces is explicitly structured around an exposure to world cultures through art and literature. The philosophy survey is more internally oriented toward the development of American civic culture out of the strands of the western tradition. The GCSP sections of these courses will maintain this foundational pedagogical commitment, but develop curriculum through which students can evaluate the cultural parameters of grand technological challenges. For example, an assignment to read the U.S. Supreme Court opinion in *Charles River Bridge* in SSC2423, fulfilling the curricular mandate to assign primary sources in U.S. Constitutional theory and set within the broader context of the western philosophical canon, immediately raises this discussion point, "which is more conducive to technological progress: a libertarian or a communitarian property tradition?"

The Jr/Sr Humanities electives are the primary place where LTU students can opt to take courses explicitly oriented toward multi-cultural studies: African-American or Japanese History, Women in Literature, etc. Cultural studies undergirds a much wider portion of HSSC's offerings. The Bible as Literature or Philosophy of Mind are intrinsically cultural studies courses. The GCSP program offers an opportunity to develop electives that explicitly engage the cultural dimensions of technological challenges. SSC4513: The Geopolitics of Natural Resources, for example, required students to evaluate national political ideologies in terms of their position in the production-consumption resource cycle. A proposed Biomedical Ethics course would have to deal explicitly with diverse cultural attitudes toward the body, death, consent, etc. Multiculturalism will constitute one of the criteria applied by the Oversight Board in designating electives as GCSP.

Beyond the curriculum, LTU GCSP students will be members of a truly international campus community in which all students are routinely required to work in teams with students from different backgrounds. The University sponsors a wide variety of initiatives to increase cultural and gender diversity in the STEM fields, including the President's Global Villages project which began as a welcome week for international students and has grown into a year-long series of multi-cultural events. LTU has been a flagship school for the State of Michigan's King, Chavez, Parks (KCP) Grant Program dedicated to increasing cultural diversity in the STEM fields, recently receiving a full renewal of our seven-year grant. LTU's STEM Center Director, Dr. Sibrina Collins, has become another nexus for K-12 STEM education outreach in Metro Detroit with the goal of increasing diversity in the STEM pipeline to college. All of these efforts have received an enormous boost from the recent award of a Howard Hughes Medical Institute grant to the COAS to support diversity efforts in the STEM fields, and which will orient the next phase of the CURE program's development.

GCSP students with a passion to focus on multicultural issues can participate in any number of these activities and formalize their experience by joining the Blue Ambassadors Program, a proposed service-learning unit within LTU's GCSP. The program is better described below, under the Social Consciousness Competency that refers to service learning.

e.  **Social Consciousness**

The values described by the NAE under the Social Consciousness Competency are more familiar to LTU faculty and students by the labels "Leadership" and "Professional Ethics." It is primarily in our Leadership and Ethics courses that we require students to reflect on the social consequences of technological change, and try to inspire them with a sense of the social responsibility that their technical knowledge entails. For more than a decade, the University's commitment to developing socially responsible engineers and scientists was embodied in its Leadership Program, requiring all LTU students to take a leadership class or perform a service-learning project each of their four years. The Leadership Program was so successful at disseminating its values throughout the curriculum, and its institutional structure became so focused upon extra-curricular service-learning opportunities, the LTU faculty returned the curricular requirement to the colleges to develop more field-specific course requirements.

Out of this recent transition, CoE's EGE3022: Leadership and Professional Development, and CoAS's Pathways Program, were born. These courses have incorporated the Leadership and Professional Ethics University Learning Outcomes, along with the best adapted curricular elements of the former Leadership courses, as their starting point. In both courses, students experience the challenges and potential of teamwork, and exercise different leadership strategies for realizing that potential. And both course are better positioned than the former Leadership Program to orient those experiences around STEM research and design.

LTU's strong service-learning culture remains, along with a wide variety of volunteering opportunities now organized principally through the Dean of Students Office. LTU's GCSP will make its contribution to this mission through the Blue Ambassadors Program. This program was initially conceived as an appendage to our efforts to introduce the GCSP to Metro Detroit high school students through the University's dual-enrolled course program. EGE1001 and COM1001, structured around a research-poster project focusing on one of the Grand Challenges, are ideally suited vehicles for STEM outreach. The Blue Ambassadors were initially conceived as LTU GCSP students who would mentor high school students in research projects for the courses. This initial concept has become elaborated into a assortment of service-learning opportunities that focus on STEM outreach. LTU's STEM Center hosts "Extreme Science Saturdays" for K-12 students throughout the year, and STEM camps in the summer. LTU's Robofest Program is a K-12 robotics curriculum and competition season, where GCSP students would be welcome as Blue Ambassadors for the GCSP.

3. **Mentoring and Thematic Connectivity**

LTU's GCSP model, with its carefully knit sequence of core requirements, is adapted to our institutional context. Our small size and the Core Curriculum structure of our general education requirements render it necessary to embed a specific, tight course sequence into the program requirements. This model, however, poses challenges for permitting students a sufficient range of GCSP options to encourage a sustained engagement with a particular Grand Challenge or Grand Challenge theme: thematic connectivity. We do not yet have sufficient GCSP course offerings in subfields to permit students to complete the program within distinct tracks. This constraint will ease as the program grows. Launching from a foundation in the colleges' first-year fundamentals courses, we expect to add more GCSP offerings among advanced program courses as these first cohorts work through the institution.

LTU's core GCSP offerings are eponymous insofar as they permit students wide latitude in choosing the focus of their class projects. In COM1001 and EGE1001, students are required to choose any of the fourteen Grand Challenges around which to design a research poster. For students who then apply to the GCS program, this assignment provides a lodestar for their GCSP faculty mentor to guide their choices in subsequent courses. EGE2123 provides a comparatively narrow range of options for the products in development, but is entirely open toward the construction of multi-disciplinary teams and the skill sets each member contributes. The GCSP liberal-arts Core courses engage broad themes of science and technology as cultural instruments, and invite students to draw upon problems from their particular major fields. The GCSP Humanities research seminars are developed in collaboration with STEM faculty to support ongoing research projects, and will proliferate and diversify as GCSP students advance through their programs.

The key to thematic connectivity for LTU's Grand Challenge Scholars will be close mentoring between student and their GCSP mentor, and then active collaboration between that mentor and the faculty assigned to the core program courses. Our goal is not narrowly prescribed thematic tracks, but rather to facilitate a coherent progression from students' initial inspiration to their final research project, through successive stages of developing competencies. That coherence will be structured by and reflected in scholars' Grand Challenges portfolios, and finally will be the responsibility of the mentor to justify before the Oversight Board for students' certification.

4. **GCSP Oversight Board**

A GCSP Oversight Board will be established, consisting of the following membership:

Administrative leadership:
- GCSP Director: Prof Ty Faulkner, CoAS Pathways Program Leader
- Dean's Office representatives
  - Dr. Selin Arslan, CoE Assoc Dean for Undergraduate Programs
  - Dr. Lior Shamir, CoAS Assoc Dean for Research

Faculty leadership:

College of Engineering
- Faculty leader: Heidi Morano, Project Engineer, Entrepreneurial Design Studio
- Dr. Adam Lobbestael, Asst Prof in Civil Engineering
- Dr. Nicole Annis-Aajaj, Asst Prof in Civil and Architectural Engineering
- Dr. Wuming Jing, Asst Prof in Mechanical Engineering
- Dr. Hamid Vejdani, Asst Prof in Mechanical Engineering
- Michael Lancina, Senior Lecturer in Biomedical Engineering

College of Arts & Sciences
- Faculty leader: Dr. Jason Barrett, Humanities Dept Chair, Teagle P.I.
- Dr. Patrick Nelson, Math & Comp Sci Dept Chair
- Dr. Julie Zweisler-Vollick, Natural Sciences Asst Dept Chair and MCB Program Director
- Dr. Franco Delogu, Assoc Prof and Program Director, Psychology
- Dr. Dan Shargel, Asst Prof of Philosophy
- Dr. Paul Jaussen, Asst Prof of Literature
- Sara Lamers, Senior Lecturer in Creative Writing
- Dan Mulder, Lecturer in Economics

University support services:
- Dr. Sibrina Collins, STEM Center Director
- Dr. Jeff Morrissette, QUEST Program Director
- Dr. Shannon Timmons, Honors Program Director

- Dr. Matt Cole, Research Support Services Committee (RSSC) rep

The GCSP Oversight Board's responsibilities will include:

- Marketing program and recruiting students
- Mentoring
- Administrative oversight of applications, tracking progress and conferring completion certificates
- Curriculum oversight: scheduling / developing faculty for "Grand Challenge" sections, developing new electives
- Program assessment
- Developing Grand Challenge research opportunities
- Sponsoring co-curricular activities associated with GCSP
- Developing grants and funding opportunities.

## 5. Student Recruitment

All incoming freshmen will be contacted with information about the GCSP program and their potential participation during the summer before they arrive on campus. Students will then be formally recruited for Lawrence Tech's GCSP in one of two required, first-semester courses. All Engineering students take EGE1001: Fundamentals of Engineering Design Projects while all Arts & Sciences students take COM1001: Pathways to Research Careers. In each of these courses, an existing, standardized GCSP module will make students aware of the program, its goals and the opportunities available to students who join. Students will be encouraged to apply in their first semester. Interested students will be directed to the GCSP faculty program coordinator within their college. The director can then mentor and guide them through the application process.

## 6. Application and Selection of Students

Applications for GCSP participation will take place each fall and spring term. The application will consist of an application form, a written statement, and a letter of recommendation. The application form will require students to devise a plan for completing the program requirements. The written statement will also require students to respond to this essay prompt:

> *Select one of the NAE Grand Challenges and discuss why you are passionate about finding a solution to this challenge. What do you feel are the primary obstacles to solving this challenge? What personal and professional opportunities do you see related to solving this challenge?*

All students with freshman and sophomore standing (< 60 credit hours) will be eligible to apply to the program. First-semester juniors may also apply (61-75 credit hours), but may be required to complete remedial coursework to fulfill earlier completion requirements. Second-semester juniors and seniors will not be eligible to apply for the program, as the steering committee intends for the GCSP to be an integral component of GC Scholars' undergraduate education, as opposed to having students who inadvertently complete requirements apply their coursework to the certificate retroactively or as an afterthought.

In an effort to create a diverse and inclusive GCSP, there will be no minimum GPA requirement for participation in the GCSP. Selected students will demonstrate passion for one or more of the NAE Grand Challenges. If interest in the GCSP is not sufficiently strong among diverse students, the GCSP Oversight Committee will work to increase diverse student interest in the GCSP. Once selected to be part of the GCSP, each student will meet at least once per semester with the GCSP Co-Director for their college to confirm the student is making sufficient progress towards completing GCSP requirements.

## 7. Assessment

Students will create a portfolio documenting their participation in the GCSP as they progress through the program. This portfolio will include the final paper on their research/design experience as well as samples of work, written reflections, and documentation of how the student has fulfilled each competency of the GCSP. The GCSP faculty oversight committee will review the final transcripts and work portfolio of students completing the program in order to confer the GCSP designation upon graduation.

Upon successful completion of all program requirements, students will be recognized as GCSP scholars with a certificate of completion conferred at a spring awards banquet and recognition in the graduation program.

## 8. Resources

Two principal types of resources will be required for the GCS Program: a) the labor-hours of faculty-staff to administer the program, and b) money to support research and extra- / co- curricular experiences not-directly-funded by credit-hour tuition.

The program can be driven by three personnel positions: an admin/staff coordinator, and a senior faculty leader from each college. The coordinator will require a substantial portion of their annual workload dedicated to the GCSP. Until the program grows in student participation, the college faculty leaders will accommodate their GCSP responsibilities within their service obligations. These three GCSP positions will draw upon the resources available among the Oversight Board members where necessary for specific tasks.

Student research at LTU is funded primarily by tuition, industry sponsorships, and faculty grants.  The Oversight Board will be responsible for mining those sources and developing external funding. The Teagle Foundation grant has funded the development of the greatest part of the new curriculum for the program.  Some additional University/college support will be necessary when the Teagle grant expires in order to fund service learning opportunities, GCSP special events, new electives, supporting smaller caps on GCSP sections, facilitating team-teaching, and other program related expenses.

## 9. Appendix 1: Complete Mapping of Five GCSP Competencies at LTU

| LTU GCSP Learning Objective | Curricular Activity | Co-Curricular Activity |
|---|---|---|
| **Research/creative -** Demonstrate the ability to complete a research or capstone project related to a Grand Challenge. | • Senior capstone projects<br>• Directed study / Faculty research project | • Research internship/co-op<br>• Summer research opportunity (REU)<br>• Start Up research semester |
| **Interdisciplinary -** Demonstrate the ability to work at the boundaries between technical and non-technical areas when solving problems related to a Grand Challenge. | • LLT1213: World Masterpieces 1 (GCSP)<br>• LLT1223: World Masterpieces 2 (GCSP)<br>• SSC2413: Foundations of American Experience (GCSP)<br>• SSC2423: Development American Experience (GCSP)<br>• Junior/Senior GCSP Humanities elective<br>• EGE2123: Entrepreneurial Eng Design Studio<br>• COM1001: Pathways to Research Careers<br>• COM4001: Pathways Career Lab | • Blue Devil Ambassadors<br>• Service learning/Study abroad experiences<br>• Other co-curricular activities |
| **Business/entrepreneurship -** Demonstrate the ability to implement innovation and translate invention into market ventures. | • EGE1001 Fundamentals of Eng Design Projects<br>• EGE2123: Entrepreneurial Eng Design Studio<br>• EGE3022: Leadership and Prof Development for Eng<br>• Senior Capstone Projects<br>• Courses specific to GCSP degree programs | • LTU Innovation Encounter<br>• LTU versus Eaton Design Challenge |
| **Multicultural -** a. Demonstrate knowledge of issues related to developing innovation in a global economy. b. Demonstrate knowledge of global issues related to solving a Grand Challenge. | • LLT1213: World Masterpieces 1 (GCSP)<br>• LLT1223: World Masterpieces 2 (GCSP)<br>• SSC2413: Foundations of American Experience (GCSP)<br>• SSC2423: Development American Experience (GCSP)<br>• Junior/Senior GCSP Humanities elective<br>• EGE1001 Fundamentals of Eng Design Projects<br>• EGE2123: Entrepreneurial Eng Design Studio<br>• COM1001: Pathways to Research Careers<br>• COM4001: Pathways Career Lab<br>• Courses specific to GCSP degree programs | • Blue Devil Ambassadors<br>• Service learning/Study abroad experiences<br>• Other co-curricular activities |
| **Social consciousness -** a. Demonstrate social awareness. b. Demonstrate motivation to bring technical knowledge to bear on societal problems. | • LLT1213: World Masterpieces 1 (GCSP)<br>• LLT1223: World Masterpieces 2 (GCSP)<br>• SSC2413: Foundations of American Experience (GCSP)<br>• SSC2423: Development American Experience (GCSP)<br>• Junior/Senior GCSP Humanities elective<br>• EGE1001 Fundamentals of Eng Design Projects<br>• EGE2123: Entrepreneurial Eng Design Studio<br>• EGE3022: Leadership and Prof Development for Eng<br>• COM1001: Pathways to Research Careers<br>• COM4001: Pathways Career Lab<br>• Senior Capstone Projects<br>• Courses specific to GCSP degree programs | • Blue Devil Ambassadors<br>• Service learning/Study abroad experiences<br>• Other co-curricular activities |