New Jersey Institute of Technology
Newark College of Engineering
Grand Challenges Scholars Program Proposal

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1. Mission, Goals and Vision

Mission:
The New Jersey Institute of Technology (NJIT) Grand Challenges Scholar Program (“the program” or GCSP) develops a series of public presentations and implementation projects in NJIT’s community, inspired by the National Academy of Engineering Grand Challenges for Engineering and meeting the five competencies declared by the NAE Grand Challenges Scholars Program (namely, talent competency; multidisciplinary competency; viable business/entrepreneurship competency; multicultural competency; and social consciousness competency). The program aligns with NJIT’s primary mission of pursuit of academic excellence while preparing students for productive careers and lifelong learning. NJIT is known for providing students hands-on experiences with a strong focus on experiential learning opportunities that include research and service-based learning projects.

The program serves primarily students of engineering and science at NJIT and has additional impact on community beneficiaries outside of NJIT – through projects initiated and implemented by the students in the NJIT environment (mostly the City of Newark). The program would also engage students of other professional areas in targeted projects, including students of Management and Architecture.

Among the activities organized by the program are student projects within NJIT and the school’s external environment (especially the neighborhoods of Newark, New Jersey). These projects are meant to achieve the following goals:

1. Improve understanding of engineering and the engineering design process by all constituents
2. Articulate the societal impact of engineering and exemplify it by activities that benefit the NJIT environment and the public in general
3. Develop understanding and field experience with elements of management, business, budgeting and entrepreneurship associated with engineering projects
4. Provide participants with a window toward activities in disciplines other than their own
5. Strengthen the bonds between NJIT and its neighboring communities using engineering projects as a vehicle.

**Vision:**
The program aims to make NJIT students, graduates of NJIT, and other participating constituencies enthusiastic about engineering and engineering design. At the same time, these participants would become better equipped to assess and consider the limitations and constraints of engineering, and the societal impact (positive and negative) of engineering projects. This objective is part of NJIT’s ongoing drive to prepare engineers who have a wider understanding and viewpoint than the typical, somewhat narrow-focused, “subject matter experts” that many engineering programs tend to prepare.

The GCSP at the NJIT is ideal for the socially-conscious students that want to have an impact on the world’s most compelling issues. Whether a student is interested in providing access to clean water or restoring urban infrastructure, this program will provides an experiential path to understanding and potentially providing solutions to the National Academy of Engineering’s Grand Challenges under the four themes: Sustainability, Health, Security, and Joy of Living. The GCSP aims to develop the engineering leaders needed to confront these global challenges. This program will inspire students to become more socially conscious, innovative, passionate, and engaged in the field of engineering. NJIT’s GCSP will encourage students to tailor their learning experience beyond traditional coursework, preparing Scholars to enter the workforce equipped with the tools and skills necessary to have an impact on the issues our world faces today.
We hope that students who participated in the NJIT Grand Challenges for engineering program would develop their own personal ‘Grand Challenge’ in one of the four themes: Sustainability, Health, Security, and the Joy of Living. This process means that they adopt elements of the NAE challenges for their own professional work and development, or that they create new challenges in their own organizations and enterprises that fit their environment, constituencies, aspirations, and skill sets.

The program competencies and themes are central to NJIT’s core values, namely, Excellence, Integrity, Civility, Social Responsibility, Diversity, and Communication.

2. *Steering Committee*

The Steering Committee for the Grand Challenges Scholar Program will oversee administration and assessment to ensure regular feedback, continuous improvement, and appropriate oversight. The Director of the GCSP will serve as the chair of this committee. Other members of the committee will include representation from each participating college, Faculty Mentors, an academic advisor, and a student representative. The chair of the steering committee will hold regular monthly meetings. The chair will also be responsible for updating the committee on GCSP best practices and other important programmatic information. The leadership team for GCSP at NJIT includes NCE Dean Dr. Moshe Kam, Associate Dean for Academic Affairs Dr. Edwin Hou, GCSP Director and Chair of the Steering Committee Dr. Ashish Borgaonkar, GCSP Contact Dr. Lisa Axe, and representatives from each of the other participating colleges. The program is proposed by the Newark College of Engineering with endorsement from the University Provost Dr. Fadi Deek. We will seek endorsements from other colleges at NJIT before the program is made available to non-NCE students.

GCSP steering committee will be responsible for

- Establishing and updating learning outcomes, goals, and objectives of the program.
- Reviewing progress reports of GCSP participants.
• Recruiting and training faculty mentors interested in GCSP program.
• Compiling names and accomplishments of GCSP participants.
• Preparing the annual report.
• Participating in assessment and continuous improvement of the program.

3. Recruitment and Selection

New Jersey Institute of Technology (NJIT) is one of the nation’s leading polytechnic universities. As such, NJIT prepares students to be leaders in our technology-dependent economy of the 21st century. The vast majority of NJIT’s 11,000+ graduate and undergraduate students pursue STEM education. More than half of this population is part of the Newark College of Engineering (NCE), NJIT’s oldest and largest college. NCE attracts high achieving students in the region and offers them a high quality education that is an efficient blend of a challenging curriculum, scholarly pursuits, research, leadership activities, and community service. Our goal is to give students from our diverse student body the opportunity to become Scholars with the support needed to explore and excel as a Grand Challenges Scholar.

Recruitment of students for the program:
Eligibility: Students interested in becoming a scholar in the program will need to meet the following requirements. Non-NCE students interested in engineering grand challenges are also welcome to apply.

The Program Requirements are as follows:

1. Students must submit a letter of interest stating why they are interested in the program. Additionally, a letter of support is needed from the student’s FED 101 instructor (or from the instructor of equivalent first year course in the student’s major). Once the Program is in place, current students that have completed their first year will have an opportunity to apply and will need a letter of support from one of their instructors in their program.
2. A minimum cumulative grade point average of 2.75 (In some special cases, students with a GPA >2.5 will also be considered) must be maintained.

3. Selected students must register for ENGR290: Perspectives of the Grand Challenges and receive the satisfactory grade.

4. Make satisfactory progress towards completing the GCSP including completion of all required elements and successfully complete all GCSP courses (D or better grade in each course). Please refer to Appendix A for additional information on the GCSP courses and the impact on the program.

Recruitment Process:

- Incoming Fall 2018 class will be considered for the program.
- Information sessions will be conducted for Fundamentals of Engineering Design (FED101) instructors, who will recommend NCE students for the program at the end of Fall and Spring semesters. FED101 instructors will share the program details with students in their classes.
- All students are welcome to present their interest in the program and qualifications to their instructors; they may request a recommendation for participation.
- The Pilot offering will include about 20 NCE students.
- Interested students will submit a letter of interest and enroll in the Perspectives of the Grand Challenges Course (ENGR290) in the subsequent fall semester. In the pilot (first cohort), only students accepted into the program may enroll in the ENGR 290 course.
- It is our intention to eventually expand this program to include participants from all NJIT colleges. We will seek endorsements from the Deans of other colleges within NJIT at the end of first year of the pilot offering. Upon expansion, the GCSP Director will coordinate with associate deans of other NJIT colleges to identify instructors of suitable first year courses within those colleges, who will be given information about the Program with a request to identify and recommend (non-NCE) students suitable for and interested in participating in Program. The GCSP
Director will work with participating colleges to identify additional courses to satisfy GCSP requirements for non-NCE students.

- Students that are not selected are allowed to reapply but must wait at least one semester before they can reapply.

The GCSP steering committee will evaluate all applications on the basis of students meeting the program requirements, quality of the letter of interest as well as the support letter(s). The GCSP director will identify reviewers from among the committee based on applicants major and the grand challenge(s) they are interested in. FED101 instructors will recommend students for the program; these students will be invited to an information session and will be encouraged to submit an application. All FED101 instructors, GCSP faculty advisors, and academic advisors will also be invited to such information sessions. As part of their FED101 course, students participate in a variety of engineering design, hand-on, and other activities that are sometimes individual, but more often groups. FED101 instructors are very well placed to evaluate students on their passion for engineering, ability to engage (at this time) in research opportunities and projects outside of class while maintaining their class load, work in groups, innovative design ideas, and strong will to make a positive impact on the society that engineers serve. All of these are important characteristics to succeed in engineering as well as the Grand Challenges Program.

4. Faculty Mentors

Students participating in GCSP will be assigned a Faculty Mentor by the GCSP Director based on their major who will advise them towards successful completion of program requirements. This advisement will include connecting students with faculty engaged in research in one of the themes of grand challenges. Mentors will be faculty members that are active researchers in a Grand Challenges Theme and may or may not be the members of the steering committee. Students will be required to meet with their mentor at least once a semester. These meetings will allow the mentors to review the progress of their advisees and provide input, support,
and guidance. The meetings will also allow students to share their experiences in the GCSP and to assist in guiding them in their Theme and Challenge of interest.

GCSP mentors will receive training and support in the following ways:

- Annual Mentor Workshop and Networking Event that will include a panel discussion and feedback session.
- Access to online material and a forum for the mentors where ideas, problems, and solutions can be shared.
- Support from students’ departmental academic advisor and the advising success center.

5. Funding and Support

NJIT is committed to establishing an engaging and effective GCSP. We are also committed to continuously improving the NJIT GCSP. As such, the sustainability of this program is an important consideration. A number of resources are required to support and sustain this program. These resources include a stipend and course release for the director, a marketing budget, staffing needs, stipends or release time for mentors, travel to conferences and meetings, and support for student projects. The steering committee may identify other needs from time to time after the program is up and running. As such, the budget will be supplemented as needed. Table 1 lists costs associated with the program. Internal funding will be used to support this budget, which will include funds from the Provost office and the Deans of each of the participating colleges. The Dean of Engineering has committed funds to support the program for the next six years.

Table 1. Costs to initiate GCSP at NJIT

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Director Stipend/Course Release</td>
<td>$15,000</td>
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<tr>
<td>Staffing</td>
<td>$20,000</td>
</tr>
<tr>
<td>PR, Marketing and Outreach</td>
<td>$10,000</td>
</tr>
<tr>
<td>Support for Student Projects</td>
<td>$15,000</td>
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<td>-----------------------------</td>
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</tr>
<tr>
<td>Mentor Support</td>
<td>$10,000</td>
</tr>
<tr>
<td>Travel</td>
<td>$10,000</td>
</tr>
<tr>
<td><strong>Total Cost for the First Year</strong></td>
<td><strong>$75,000</strong></td>
</tr>
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</table>

6. **Unique Aspects**
This Grand Challenges Scholar Program takes advantage of NJIT’s hands-on approach to learning where students apply fundamentals from their courses in solving real-world problems. In the classroom, this approach is exemplified in an active learning environment and in project-based learning. Importantly, this GCSP initiative will be focused on providing students continuous experiential learning opportunities through the creative technical competency where students will engage in research experiences for undergraduates. In addition, through the business competency students will have an opportunity to participate in the NJIT National Science Foundation (NSF) I-Corps grant dedicated to transferring technology to the commercialization phase. The integration of the *cultural* and a *social consciousness competencies* provides opportunities for building learning communities to collaborate on service-based learning projects.

7. **GSCP Components**
Requirements to complete the GCSP involve a plan that takes advantage of the creative and engaging courses, with NJIT Faculty, and the dedicated staff that supports the NJIT students. Students will develop their plan by the conclusion of their first semester in the program; the plan must be reviewed with their faculty mentor. The GSCP competencies include the following (Please refer to Appendix A for additional details on GCSP courses):

- **Multidisciplinarity:** In fulfilling the multidisciplinary competency, students admitted into the GCSP will enroll (for the fall semester) in the Perspectives of the Grand Challenges (ENGR 290 a 1 credit course) as the first step in becoming a Scholar. Seven engaging
colloquia will be offered every fall semester. Faculty conducting research in a Grand Challenges Themes will present the colloquia with one faculty member presenting at each colloquium. At the conclusion of each faculty presentation, students will engage in an activity organized to focus on exploring a potential engineering solution, addressing societal impacts, and holding debates on differing perspectives. During the inaugural year, only the engineering faculty members will be selected to present at the colloquia but as the program grows we will expand the faculty involvement to include members of other colleges at NJIT that are engaged in research aligned with one of the grand challenges. In addition to this experience, students will have opportunities to enroll in other interdisciplinary courses offered at NJIT. Students will work with their GCSP faculty advisor to identify and enroll in a 3-credit multi-disciplinary course in order to fulfill this competency.

- **Talent:** *In this creative technical competency, each student will select a Faculty Advisor focused on their Grand Challenge Theme will need to enroll in a minimum of one engineering research/project course focused on this topic.* This research/project is to be conducted under the advisement of the faculty advisor conducting research in a Grand Challenges Theme. Students may participate in undergraduate research experiences offered during the summer terms. Additional opportunities will include enrolling in two GCSP courses that will be created for this track through the Dean’s Office: 1. ENGR 491 (3 credits), and 2. ENGR 492 (3 credits). These courses fill technical electives in curricula. Students must enroll in a minimum of ENGR 491 and conduct a minimum of 180 hours of research per course (15 weeks x (3 hours [contact time] + 9 hours [effort outside of contact hours])).

- **Viable Business/Entrepreneurship:** *In this business competency* and as part of applying a viable business model in developing and implementing solutions, a Grand Challenges Scholar will need to submit their planned courses for approval to demonstrate how the plan supports their Grand Challenges Theme. One potential management course that may be helpful for the business competency is ENTR 410 New Venture Management (NJIT Catalog description -- Prerequisite: Junior standing. This course provides an
understanding of the process of start up and early stage management of new, technology based, small firms. Emphasis is on recognizing, evaluating and deciding on a new business idea, as well as preparation for and management of the start-up process. Preparation and execution of a new business plan.). Alternatively, should a student’s research/project involve an National Science Foundation (NSF) I-Corps grant, then this would fulfill the entrepreneurship requirement. The selected course or project must be approved in advance by the Faculty Advisor. The intent is that this course fulfills the GER management/social science requirement (with approval from the student’s home department). In addition, students may also submit other relevant NJIT courses for approval to the faculty advisor for consideration in satisfying this competency.

• **Multicultural Understanding and Social Consciousness:** Through experiential learning, students will engage in acquiring both a *cultural competency* and a *social consciousness competency*. Each student will be required to enroll in ENGR 493 (3 credits) Service Learning for Engineers. A host of opportunities are available for fulfilling these competencies: an experience will require prior approval of the Faculty Mentor and students will be required to develop a plan in carrying out the experience. This course/experience fulfills a technical elective in the program. Potential opportunities include but are not limited to 1. An Engineers without Borders project, 2. An EPICS project, 3. A global internship or cooperative education experience, and 4. A study abroad experience.

Throughout the program, students will be responsible for developing a portfolio, which will help students to showcase accomplishments, reflect on their experiences, and consider how the elements of their experience are connected. In a panel, students will share portfolios at the conclusion of their program during an annual meeting of the program participants at NJIT. This opportunity will support a final reflection of the GCSP experience.

8. **Mentorship, Support, Tracking, and Assessment**

*Mentorship and Support:*
• Each GCSP participant will be assigned a Faculty Mentor for support in this Grand Challenges Scholar Program.

• In addition, all participants will be guided by a Faculty Advisor (who may be their mentor as well) for their research. Faculty Advisors will be selected based on the student’s interest and focus in a Grand Challenges Theme.

• Networking meetings will be held during the fall and spring semesters to allow the Faculty Mentors (with a letter of support from the Faculty Advisor) to review progress of the students, discuss ideas, and provide feedback.

• Regular meetings will also be held of the Steering Committees that Faculty Mentors are members of to discuss the program progress, troubleshoot problems, identify challenges, and support continued growth of the program.

• We will work with the Student Senate to form and officially recognize Grand Challenges Scholars Club. All students in the program will be members of this club and will support and encourage each other through various meetings, events, and activities.

Assessment: NJIT will assess the GCSP to facilitate continuous improvement as well as the impact of the program on student participants. One of the primary tasks of the Steering Committee will be to develop a detailed assessment plan that will allow us to monitor student progress through the competencies and to address whether the program is meeting the learning and programmatic objectives. In addition, we will conduct surveys (including employer surveys for students participating in internships and cooperative education experiences), hold feedback sessions, and sponsor forums for students in the program. From the assessment tools, action plans will be developed and shared with students, faculty, advisors, and staff for ensuring program improvement.

9. Recognition
NJIT will utilize various platforms and mechanisms to recognize the students that successfully complete the program.
• Recognition on the NAE website.
• GC Scholar status will be identified on the official NJIT transcript.
• Certificate of completion and a graduation medal will be awarded annually at Commencement.
• Each participating class will work together and with the Grand Challenges Scholars Club to design and 3-D print a special memento in the NJIT makerspace. These mementos will be given to all students that successfully complete the program.
• Select GCSP scholars will be invited to present their experience and accomplishments to the new students attending ENGR290.
• An annual GCSP Celebration will be held to recognize graduating Scholars and also to provide an opportunity for new participants to network with graduating scholars and benefit from their experience.
### Appendix A: Table of Competencies, NCE Requirement, and the Impact on the Program

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<thead>
<tr>
<th>Competency</th>
<th>Requirement for the Grand Challenges Scholar</th>
<th>Impact on the Program</th>
</tr>
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<tbody>
<tr>
<td><strong>Multidisciplinary:</strong> Understanding gained through experience of the multidisciplinary character of implementable and viable Grand Challenge solutions.</td>
<td>Students admitted into the GCSP will enroll (for the fall semester) in the <em>Perspectives of the Grand Challenges (ENGR 290, a 1 credit course)</em> as the first step in becoming a Scholar. Seven engaging colloquia will be offered every fall semester. Faculty conducting research in a Grand Challenges Theme will present the colloquia with one faculty member presenting at each colloquium. At the conclusion of each faculty presentation, students will engage in an activity organized to focus on exploring a potential engineering solution, addressing societal impacts, and holding debates on differing perspectives. In addition, students will work with their GCSP faculty advisor to enroll in a 3-credit multidisciplinary course. Examples of such courses include (but not limited to) ENGR423 – Drone Science Fundamentals, ENGR400 – Multidisciplinary Engineering Design Project.</td>
<td>Adds 1 credit to the program (ENGR290) Examples of Multidisciplinary Courses Offered: ENGR423, ENGR400</td>
</tr>
<tr>
<td><strong>Talent - Research/creative:</strong> Mentored research or project experience related to a Grand Challenge to enhance technical competence and creativity.</td>
<td>Students will select a Faculty Mentor focused on a Grand Challenge-like topic and will need to enroll in a minimum of one honors research/project course focused on this topic. This research/project is to be conducted under the advisement of the faculty advisor conducting research in a Grand Challenges Theme. Two GCSP courses will be created for this track through the Dean's Office: 1. ENGR 491 (3 credits), and 2. ENGR 492 (3 credits). These courses fill technical electives in curricula. Students must conduct a minimum of 180 hours of research per course (15 weeks x (3 hours [contact time] + 9 hours [effort outside of contact hours])). ENGR 491 and ENGR 492 may be used to fulfill technical electives in the program (e.g., ChE curriculum has three electives). Students will be required to conduct over 150 hours of research.</td>
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<tr>
<td><strong>Business/entrepreneurship:</strong> Understanding gained through experience that viable business models are necessary for successful implementation of Grand Challenge solutions.</td>
<td>A Grand Challenges Scholar will have two options: one option is to enroll a management course through the Martin Tuchman School of Management (MTSM). A potential management course that would fulfill the business competency is ENTR 410 New Venture Management (NJIT Catalog description -- Prerequisite: Junior standing. This course provides an understanding of the process of start up and early stage management of new, technology based, small firms. Emphasis is on recognizing, evaluating and deciding on a new business idea, as well as preparation for and management of the start-up process. Preparation and execution of a new business plan.). Potentially fulfills the GER Management/Social Science requirement if a course is taken.</td>
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<thead>
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<tr>
<td>Competency</td>
<td>Alternatively, should a student’s research/project involve an National Science Foundation (NSF) l-Corps grant, then this would fulfill the entrepreneurship requirement. The selected course or project must be approved in advance by the GCSP Faculty Advisor. The intent is that this course fulfills the GER management/social science requirement (with approval from the student’s home department).</td>
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<tr>
<td>Global Dimension:</td>
<td>Through service experiential learning, students will engage in acquiring the <em>cultural competency</em>. Each student will be required to enroll in ENGR 493 (3 credits) Service Learning for Engineers. A host of opportunities are available for fulfilling this competency: an experience will require prior approval of the GCSP Faculty Advisor and students will be required to develop a plan in carrying out the experience. Potential opportunities include but are not limited to 1. An Engineers without Borders project, 2. An EPICS project, 3. A global internship or cooperative education experience, and 4. A study abroad experience.</td>
<td>ENGR 493 may be used to fulfill a technical elective in the program. It is expected that students will conduct over 100 hours in this experience.</td>
</tr>
<tr>
<td>Multicultural</td>
<td>Through community service and volunteering opportunities, students will engage in acquiring the <em>social consciousness competency</em>. Each student will be required to complete social consciousness competency by participating in at least 100 hours of community and social service opportunities. The 100 hour participation requirement must be completed in no more than two consecutive semesters. A host of opportunities are available for fulfilling these competencies: an experience will require prior approval of the GCSP Faculty Advisor and students will be required to develop a plan in carrying out the experience. Potential opportunities include but are not limited to 1. NJIT’s Alternate Spring Break Initiative, 2. A volunteer project through NJIT’s Office of Civic Engagement, 3. Tutor and/or peer mentor in NJIT’s Educational Opportunity Program (EOP) and the EOP Summer Enrichment Program, and 4. Volunteer tutor and/or peer mentor in NJIT’s Learning Communities Program.</td>
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