The Provost's Learning Innovations Grants (PLIG) program was developed to broaden and enrich the learning experience of RIT students by funding faculty-initiated projects that enhance student learning. More than 200 RIT faculty projects have received funding since the program was initiated in AY 2000-2001. (Examples of previously funded projects are available at the PLIG website, rit.edu/ili/plig).

The launch of the Innovative Learning Institute (ILI) in 2012, and its charge to assist in the creation of exceptional learning experiences for students, led to an evaluation of PLIG and a revitalization of the program to:

• Better support dissemination of individual faculty learning to the wider faculty population
• Provide funding for the implementation of successful pilot projects
• Integrate funding with Institute priorities
• Support the scholarship of teaching and learning

The 2016 Application Form is found on page 3 of this document.

I. ELIGIBILITY

The principal applicant(s) must be tenured or tenure-track RIT faculty. PLIG 2016 projects can include visiting assistant professors, lecturers, adjunct faculty, staff, students, and other contributors.

II. PLIG TYPES

There are two types of grants—Exploration and Focus Grants—for PLIG 2016. Full details are available at rit.edu/ili/plig.

III. USE OF GRANT FUNDS

Provost’s Learning Innovations Grants for 2016 may range from $1,000-$5,000.

Examples of the use of PLIG funds include:

• Course release (reasonable, actual replacement costs for full-time, tenure-track or tenured faculty members removed from teaching)
IV. PLIG TIMELINE

The grant timeline assumes that most recipients will use Summer 2016 to plan and develop their PLIG funded project for delivery or implementation during the Fall 2016 and/or Spring 2017 semester(s). The full timeline is at rit.edu/ili/plig.

V. SELECTION COMMITTEE AND EVALUATION CRITERIA

Applications for PLIG funds are evaluated by the PLIG selection committee according to the following criteria:

- **Utility** (solves a defined problem, has potential to benefit many courses/faculty)
- **Creativity** (is a novel approach or application, represents a new paradigm)
- **Efficacy** (uses an evidence-based approach, impact to student learning and/or the student experience can be demonstrated)

Details on proposal evaluation and selection committee membership is on the website (rit.edu/ili/plig).

VI. QUESTIONS OR COMMENTS

Please email plig@rit.edu with any questions or comments.
INSTRUCTIONS
Complete this form in its entirety and email it to plig@rit.edu no later than January 27, 2016. Please note to save and rename this document substituting your name (in place of “NAME”) in the file name.

Ask your Department Head to complete the Department Head Certification and return the signed copy along with your application. Note: the signed copy may be scanned and emailed.

If you have any questions about completing this application, please email them to plig@rit.edu or call Michael Starenko at 585-475-5035.

APPLICANT INFORMATION
This application is for a:

☒ FOCUS GRANT
☐ EXPLORATION GRANT

Principal Applicant Name: Kathleen Lamkin-Kennard Email: kaleme@rit.edu

Faculty Title: Associate Professor Phone: 475-6775
(Full-time, tenured and tenure track only)

College: KGCOE Department: Mechanical Engineering

Department Head name: Dr. Risa Robinson Email: rjreme@rit.edu

Proposed Project title: A Student Centered Approach for Teaching Biomechanics and Biorobotics

Total funds requested (requests of $1,000 to $5,000 will be considered): 5,000.00

Others involved in the project (if any):

____________________________________________________
____________________________________________________
BUDGET

There is a fillable PDF worksheet to calculate your budget. You can download the worksheet at rit.edu/plig.

- The total shown on this worksheet must match the “Total funds requested” in the Applicant Information section of this application form
- If awarded, additional funds will be provided to cover any benefits and ITS expenses associated with the salary budget requested
- Note that any equipment or other materials purchased with grant funds are the property of your department and revert to the department after your project is completed

TIMELINE

Please indicate any variances to the planned PLIG 2016 schedule and your reasons. If you do not intend to deviate from the schedule, you may leave this section blank.

<table>
<thead>
<tr>
<th>Task</th>
<th>Date</th>
<th>Proposed variance and reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full project plan submitted</td>
<td>Aug. 24, 2016</td>
<td></td>
</tr>
<tr>
<td>Preliminary findings submitted</td>
<td>Jan. 25, 2017</td>
<td></td>
</tr>
<tr>
<td>Summary of final findings submitted</td>
<td>Aug. 23, 2017</td>
<td></td>
</tr>
<tr>
<td>Final budget accounting submitted</td>
<td>Aug. 23, 2017</td>
<td></td>
</tr>
<tr>
<td>Faculty Teaching and Learning Commons posting (a summary of findings, examples of teaching designs or materials, etc.) due</td>
<td>On or before Oct. 24, 2017</td>
<td></td>
</tr>
<tr>
<td>Participation in Teaching and Learning Services PLIG dissemination event</td>
<td>On or before Nov. 17, 2017</td>
<td>++</td>
</tr>
</tbody>
</table>
STATEMENT OF UTILITY (two pages maximum)

Using the proposal evaluation criteria outlined in the Evaluation section of the website (rit.edu/ili/plig), please provide an overview of the project you are proposing, including:

• Project objectives

• An explanation of the teaching/learning problem(s) it is designed to address

• An explanation of the significance of the project to student outcomes and/or the student experience.

• A brief description of how the project integrates with activity already underway at RIT in the priority area and/or how this approach has been successfully used at RIT already.

All ABET accredited programs must undergo rigorous self-study every six years to assess how well the program is meeting the established accreditation criteria. Two of the outcomes associated with the ABET accreditation process are that students demonstrate that they have "the broad education necessary to understand the impact of engineering solutions in a global and societal context" and that they have a "recognition of the need for and an ability to engage in life-long learning". These criteria have evolved as a consequence of numerous studies suggesting that engineers must be life-long learners to adapt to the rapidly changing pace of technology. However, developing the means by which these criteria get introduced into engineering courses or, more importantly, get assessed, is often challenging and may sometimes only be cursory in nature. Student centered approaches to learning are ideally suited to providing students with more significant opportunities to engage in lifelong learning and to assess engineering solutions in a global and societal context. The primary objective of this proposal is to develop a student centered course in "Biomechanics and Biorobotics". Key components of the course development process will focus on strategies for engaging students in life-long learning, understanding engineering solutions in a global and societal context, and the development of methods to assess how well students are meeting these objectives. The field of Biorobotics is ideally suited for student centered learning since it is rapidly evolving, covers a broad range of topics with global and societal impacts, and the responsibility for determining whether a robot works or not is ultimately centered on the student. Since the course topic is so well suited to student centered learning, the course will provide an ideal environment for testing out strategies for student centered learning, developing best practices for implementation of student centered activities, and the development of methods for assessing student learning in a student centered environment. Lessons learned from this course would have broad applicability throughout RIT in both ABET and non-ABET accredited programs as well as at any other ABET accredited institution. The specific objectives of the proposals are (1) to develop a hands-on course in "Biomechanics and Biorobotics" using a student-centered teaching strategy; (2) to develop simple inquiry based experimental set-ups that allow students to explore basic Biomechanics and Biorobotics concepts; (3) to implement the course and identify best practices for incorporating student centered learning activities; and (4) to disseminate the findings for broad implementation.

The course to be developed will be a dual-listed upper level undergraduate and graduate course and include topics such as Biomechanics of Human Motion, Muscle Mechanics, Prosthetic Biomechanics and Robotics, Artificial Limbs, Rehabilitation Biomechanics and Robotics, Actuators and Control, Biomimetic Robotics, Robotic Surgery, and Sensors. Students will be provided with fundamental pre-requisite knowledge related to each topic through readings, online resources, and simple instructor developed experiments then tasked to research and develop activities to teach their classmates about an additional, more advanced aspect of the topic. For example, one group might develop experiments related to the biomechanics of the hand while another group develops activities related to the biomechanics of the foot and ankle. As another example, one group might select to discuss tele-robotic surgery while another might focus on state-of-the-art actuators for robotic surgery. The advantages of the approach are that the students are likely to learn about the most state of the art technologies and will benefit from peer to peer learning. Consistent with the student centered focus, the students will be allowed to select their own topics (with some instructor guidance to ensure adequate coverage of the topic overall) and will be required to include state of the art knowledge and societal context. Hands-on demonstrations or interactive activities will be strongly encouraged. The culminating element of the course will be the design and implementation of a Biomimetic Robot or Biomedical Robotic device.
Assessment of best practices will be based on direct and indirect methods including instructor observation, student interviews and surveys, and observations of student engagement and behavior from outside observers invited to view the course. Assessment of student performance and satisfaction will be based on student achievement of course learning outcomes created as part of the course development process and student surveys. Findings and best practices will be disseminated through traditional means such as presentations at the annual American Society for Engineering Education conference and publication in educational journals. Funds are also being requested to run a workshop within Mechanical Engineering focused on student centered learning. The workshop will target faculty interested in student centered learning and provide a forum to discuss best practices observed from this project and others currently being implemented within the department. An outside with experience in developing and assessing student centered classrooms will be invited to participate in the workshop and deliver a talk that will be made available campus wide. The workshop could be expanded to the college level and beyond in subsequent years.

Numerous studies have suggested that student centered learning improves academic performance, attitudes toward learning, and persistence in programs (http://ccliconference.org/files/2010/03/Froyd_Stu-CenteredLearning.pdf). The goal of developing this student centered course is that students participating in the course will be more satisfied with their educational experience and have improved student outcomes. The outcomes targeted for improvement include those associated with lifelong learning, team based skills, and understanding the impact of technology on society. In addition to being part of the ABET criteria, these skills are also integral components of the RIT Greatness through Difference strategic plan. The multi-disciplinary content of the course also targets areas identified by RIT to be of strategic importance, including Healthcare Systems, Access and Assistive Technologies, and Biomedical Engineering. The course would expand the range of course offerings related to these topics for students throughout the College of Engineering at both the graduate and undergraduate levels and could later be combined with courses in Electrical Engineering as part of a student concentration in Robotics.

The identification of best practices associated with student centered learning would have broad applicability to many of the flipped classroom initiatives currently underway on campus as well as for others interested in expanding their more traditional lecture based approaches to teaching. Although many flipped classroom approaches are more instructor driven than student driven, the strategies and best practices for engaging students are likely very similar. Bringing faculty involved in student centered initiatives and those involved in flipped classroom approaches together is likely to foster new ideas for engaging students while furthering knowledge of best practices for hands-on, inquiry based learning.
STATEMENT OF CREATIVITY (three paragraphs maximum)

Provide a brief description of how this is a novel approach, or a new application of an existing mode or model of teaching and learning, and/or research about how teaching and learning represents an entirely new paradigm. (Please note that special consideration will be given to proposals that demonstrate a new use/application of a model, system, or technology already in use at RIT.)

The implementation of flipped classroom approaches has become more widespread over the past few years at RIT. However, the implementation across campus is varied and student acceptance of flipped classrooms is equally variable. The PI has prior experience in developing a Flipped Classroom Approach for Teaching Biomaterials and has observed a broad range of student attitudes toward the flipped approach. While the students seem to like the hands-on aspects of the course, many still have not fully accepted the flipped approach. The proposed study would focus specifically on student centered learning and could serve as a next generation extension of the flipped classroom approach. The key benefit is that the students would play a greater role in defining their educational experience than in a more traditional flipped classroom and might have an improved level of satisfaction with their educational experiences. Findings from the project could be compared and contrasted with those from flipped classroom studies to further develop best practices in student centered learning.

Implementation of the student centered approach in a Biomechanics and Biorobotics course is particularly novel since there are few courses like it in the nation and even fewer that utilize a student driven approach. RIT has the unique expertise to teach this multidisciplinary course which lends itself to student centered learning. Biorobotics is also a rapidly evolving field in which students could gain valuable experiences in lifelong learning by identifying and assessing state of the art technologies, teaching their peers about these technologies, and identifying the societal and global impacts of these technologies.
STATEMENT OF EFFICACY (two pages maximum)

Provide a brief description of the experiment/research design, methodology, and methods of data collection you will use to gauge efficacy.

The proposed study will be implemented in multiple phases between May 2016 and November 2017. The first phase of the study will involve development of the fundamental course structure, identification of experiments to be developed, and development of metrics for assessing the course outcomes and best practices. This phase of the study will be conducted between May 2016 and August 2016. The first deliverables for the project will be the course outline with learning outcomes, preliminary metrics for assessment, and experiments to be developed. The second phase of the study will involve creation of new hands-on experimental set-ups that can be used to enhance the student centered learning. These will be developed between July 2016 and January 2017. The course will be implemented in the Spring of 2017 as part of the third phase of the project. During this time, assessment of student outcomes will be ongoing, best practices will be developed, and outside observers from within the Mechanical Engineering Department will be brought in to assess student engagement. In Summer 2017, after completion of the course, best practices will be refined, findings will be compiled for dissemination, and preparation for the workshop will begin. The findings will be submitted for presentation at the ASEE Annual Conference and for journal publication. The workshop will be offered in Fall 2017.

The research design will focus on creation of course materials and hands-on experiments to enhance student learning of fundamental concepts as well as development of the structure for the student centered activities that will be the integral aspect of the course design. Laboratory exercises will be derived from applications found in the literature, ongoing related research in my laboratory, or based on feedback from industrial contacts related to desired skills for new graduates. Examples could include comparisons between the force-length relationships of McKibben style robotic actuators and human muscles or implementation of a simple resistance-based control glove for controlling biomimetic hand robots. All of the exercises would be designed to provide the students with hands-on skills as well as to integrate a variety of fundamental course topics.

The impact on student learning will be assessed through a variety of means. Each course learning outcome will be tied to specific demonstrable course events to assess specific learning outcomes. Higher level learning will be assessed through evidence based exercises done in class, such as teaching concepts to their peers. Each of the evidence based exercises will also be mapped to specific learning outcomes. Grades on each of the events will be used as the primary means of assessing achievement of the specific learning objectives. The term-long course project will also be used to demonstrate synthesis of course objectives. At multiple points during the course, surveys will be given to the students to obtain feedback about the course structure and their perceived understanding of the course material. Furthermore, feedback will be obtained relative to student engagement in and satisfaction with the course. Long term, as feasible, follow up interviews will be done with students or employers to evaluate satisfaction with the course structure and content. All of the obtained data will be used for continuous improvement of the course structure. Assessment metrics and strategies for assessing best practices will be developed based on the literature and in conjunction with individuals on campus experienced in development of similar student centered courses.
DISSEMINATION PLAN (optional)

Provide details about the journal, conference, show, or other external vehicle with strong potential for dissemination of your results. Include supporting documentation, such as preliminary interest or acceptance, with your application, if available. *(Please note that special consideration will be given to proposals that have a defined opportunity for external dissemination, such as an academic journal or professional conference.)*

ILI will arrange channels for disseminating results within RIT.

Findings from the study will be submitted for presentation at the American Society for Engineering Education (ASEE) Annual Conference as well as submitted for publication in the ASEE Computers in Education journal. The findings may also be submitted to the Transactions on Techniques in STEM Education. A workshop within the Mechanical Engineering Department will be developed to allow for sharing of best practices in the department. The workshop could be extended to the College or University level in subsequent years.
ADDITIONAL CONSIDERATIONS
Please address these questions, if needed.

Will your project require assistance for extensive or unusual media, multimedia, simulation, and/or software development? If so, please explain?

N/A

All courses offered by RIT must be accessible to students with disabilities, according to Section 504 of the Rehabilitation Act of 1973 and Title II of the Americans with Disabilities Act of 1990 (rit.edu/studentaffairs/disabilityservices/info). Is your proposed teaching approach accessible to all students, with reasonable accommodation? If not, please explain.

Yes, all activities will be accessible.

RIT abides by the Family Educational Rights and Privacy Act of 1974 (FERPA), which prohibits instructors from making students’ identities, course work, and educational records public without their consent (rit.edu/xVzNE). Will any data gathering or sharing for your project raise any FERPA issues? If so, please explain.

No
DISSEMINATION AGREEMENT

By completing this grant application, I agree to provide the materials described here, in support of disseminating what is learned from this project to other faculty at RIT.

I also agree to return all/a portion of the funds that I receive for this project to RIT if I fail to complete or provide the materials described here.

- Full project plan (including roles and responsibilities, milestone dates, and pertinent project details)
- Overview of preliminary findings (may include experiment/study design, lessons learned, initial data collection, and/or literature review summary)
- Final project summary (including data collection, lessons learned, implications for further study, and which may be in the form of an article abstract, conference presentation outline, or short report)
- Teaching and Learning Commons posting (a summary of findings and examples of teaching designs or materials)
- Participation in a faculty dissemination event
- Final budget accounting (reconciliation of budget provided with your application and the actual project expenses)

By submitting this application, I accept this agreement. KLK (Applicants initials)
DEPARTMENT HEAD CERTIFICATION

I support this PLIG application and budget, and verify that the principal applicant ___________________ is a full-time, tenured or tenure-track faculty member in good standing in my department.

Department Head Name (PRINT): __________________________ Email: __________________

Department Head Signature: ______________________________ Date: ________________
DEPARTMENT HEAD CERTIFICATION

I support this PLIG application and budget, and verify that the principal applicant, Kathi Lomkin-Kennard, is a full-time, tenured or tenure-track faculty member in good standing in my department.

Department Head Name (PRINT): RISA ROBINSON
Email: sjreme@rit.edu
Department Head Signature: [Signature]
Date: 1-25-16
# PLIG Budget Worksheet

Applicant's Name: 
Kathleen Lamkin-Kennard

<table>
<thead>
<tr>
<th>Personnel</th>
<th>Purpose/Justification</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-Time Faculty/Staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Kathleen Lamkin-Kennard</td>
<td>Summer - Course Development</td>
<td>$1,500</td>
</tr>
<tr>
<td>2 Adjuncts, Part-Time Faculty/Staff, Summer Salary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Student Workers, Graduate Assistants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 P/T Student</td>
<td>Implement and Test Experimental Setups</td>
<td>$1,250</td>
</tr>
</tbody>
</table>

- **Personnel Total**: $2,750

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Purpose/Justification</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Laboratory Equipment</td>
<td>Develop experimental test fixtures</td>
<td>$1,000</td>
</tr>
<tr>
<td>2 Course Supplies</td>
<td>Disposable supplies, such as air muscles</td>
<td>$250</td>
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</tbody>
</table>

- **Equipment Total**: $1,250

<table>
<thead>
<tr>
<th>Travel</th>
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<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Conference</td>
<td>ASEE Conference</td>
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</tbody>
</table>

- **Travel Total**: $500

<table>
<thead>
<tr>
<th>Other (Specify)</th>
<th>Purpose/Justification</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Workshop</td>
<td>Speaker expenses and other supplies</td>
<td>$500</td>
</tr>
</tbody>
</table>

- **Other Expenses Total**: $500

**Total Award Request**: $5,000