

Fall 2018

## Calculus I for Engineers (GA Southern)

Scott Kersey

Georgia Southern University, [skersey@georgiasouthern.edu](mailto:skersey@georgiasouthern.edu)

Rami Haddad

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# Grants Collection

Georgia Southern University



UNIVERSITY SYSTEM  
OF GEORGIA

Scott Kersey and Rami Haddad

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# Calculus I

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## Grants Collection

Affordable Learning Georgia Grants Collections are intended to provide faculty with the frameworks to quickly implement or revise the same materials as a Textbook Transformation Grants team, along with the aims and lessons learned from project teams during the implementation process.

Each collection contains the following materials:

- **Linked Syllabus**
  - The syllabus should provide the framework for both direct implementation of the grant team's selected and created materials and the adaptation/transformation of these materials.
- **Initial Proposal**
  - The initial proposal describes the grant project's aims in detail.
- **Final Report**
  - The final report describes the outcomes of the project and any lessons learned.



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# Initial Proposal

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## Application Details

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### Manage Application: Textbook Transformation Grants: Round Eleven

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**Award Cycle:** Round 11

**Internal Submission Deadline:** Tuesday, January 23, 2018

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**Application Title:** 350

**Application ID:** 002065

**Submitter First Name:** Scott

**Submitter Last Name:** Kersey

**Submitter Title:** Associate Professor of Mathematics

**Submitter Email Address:** skersey@georgiasouthern.edu

**Submitter Phone Number:** 912-478-1963

**Submitter Campus Role:** Proposal Investigator (Primary or additional)

**Applicant First Name:** Scott

**Applicant Last Name:** Kersey

**Applicant Email Address:** skersey@georgiasouthern.edu

**Applicant Phone Number:** 912-478-1963

**Primary Appointment Title:** Associate Professor of Mathematics

**Institution Name(s):** Georgia Southern University

**Co-Applicant(s):** Rami Haddad

**Submission Date:** Tuesday, January 23, 2018

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**Proposal Title:** 350

**Proposal Category:** No-Cost-to-Students Learning Materials

**Final Semester of Instruction:** Fall 2018

**Are you using an OpenStax textbook?:** Yes

#### Team Members (Name, Email Address):

Scott Kersey, Associate Professor of Mathematics, Department of Mathematical Sciences, [skersey@georgiasouthern.edu](mailto:skersey@georgiasouthern.edu)

Rami Haddad, Assistant Professor of Electrical Engineering, Department of Electrical and Computer Engineering, [rhaddad@georgiasouthern.edu](mailto:rhaddad@georgiasouthern.edu)

**Sponsor, (Name, Title, Department, Institution):**

Sharon Taylor, Professor and Chair, Department of Mathematical Sciences, Georgia Southern University

Youakim Kalaani, Associate Professor and Chair, Department of Electrical and Computer Engineering, Georgia Southern University

**Course Names, Course Numbers and Semesters Offered:**

Calculus I, MATH 1441, Fall, Spring, and Summer semesters (special sections for Engineering students to be piloted Fall 2018)

**List the original course materials for students (including title, whether optional or required, & cost for each item):** Thomas' Calculus with MyMathLab on line homework system access (\$288.40) or MyMathLab Student Access Kit (\$106.90). Required.

**Average Number of Students per Course Section:** 50

**Number of Course Sections Affected by Implementation in Academic Year:** 2 (Upon successful implementation more sections will be added)

**Average Number of Students Per Summer Semester:** 0

**Average Number of Students Per Fall Semester:** 100

**Average Number of Students Per Spring Semester:** 0

**Total Number of Students Affected by Implementation in Academic Year:** 100 (Upon successful implementation more students would be affected)

**Requested Amount of Funding:** 10800

**Original per Student Cost:** \$106.90-\$288.40

**Post-Proposal Projected Student Cost:** \$0

**Projected Per Student Savings:** \$106.90-\$288.40

**Projected Total Annual Student Savings:** \$10690-\$28840 for 100 students in pilot courses. (We expect this will be hundreds of thousands in the future)

### **Creation and Hosting Platforms Used ("n/a" if none):**

**Microsoft, Apple, Linux Operating Systems:** Our course materials and software will run equally-well on these operating systems. While Microsoft and Apple are not free, Linux is free and open source and used by both team members.

**Desire2Learn (D2L, Folio) [4]:** Virtual Classroom at Georgia Southern University [1]. This will be used for additional notes, handouts, modules and videos associated with the implementation of this project.

**Google Drive:** Some materials may also be stored on the university Google drive for easy access and sharing with faculty.

**Faculty Web Pages:** Team members will put materials on their university web pages.

**WeBWork [2]:** Open-source online homework management system with Open Problem Library. The library currently contains over 40,000 mathematics and science problems [3], and includes an editor for writing problems tailored to ones' course. The program was recently installed at our university, and administered by a team member (S. Kersey), who has completed a WeBWork system administrator training course hosted by the Mathematical Association (MAA). This is an open source program that is free for students and the university. WeBWork homework problems for the OpenStax Calculus I textbook were developed by one of the team members (S. Kersey) in a previous ALG grant [8].

**Matlab [5], Octave [6]:** Matlab is a scientific programming language that engineers commonly use and we will use in our course transformation. It is freely available to our students at Georgia Southern on campus and therefore is free to students in our implementation. Students off campus who do not have access to Matlab can use Octave, which is open-source and has nearly identical functionality as Matlab; i.e, the programs used in our implementation will work in either Matlab or Octave. Therefore, our implementation is zero-cost for students on or off campus.

### **Project Goals:**

Develop a new STEM mathematics class *Calculus I (for Engineers)* using zero cost-to-student open education resources (OER) based on input from both engineering and mathematics faculty by replacing two sections of *Calculus I* in the Fall 2018 semester with two sections of our new *Calculus I (for Engineers)* in the Fall 2018 semester, to be taught by the team members.

Save students money on course materials by replacing the current textbook and homework system with free open source course materials.

Improve the performance of students in engineering classes that use *Calculus I (for Engineers)* as a prerequisite by providing course content tailored to their needs in their engineering classes.

Improve the success rate for engineering students in Calculus I who take our new sections on *Calculus I (for Engineers)*.

Improve the perception of engineering faculty on the quality of the mathematics classes and mathematics faculty involved in preparing their students for the mathematics they need in their engineering classes and careers by using our OER *Calculus I (for Engineers)* course materials.

Include engineering faculty in a control loop decision-making process designed to develop course topics based on students' needs by sharing OER course materials using creative commons (CC) licensing.

Create new textbook materials, notes, worksheets, videos, assignments and projects based on input from engineering and mathematics faculty.

Develop new homework problems in WeBWork that can be shared by other faculty in and outside our institution.

Develop new computer projects in Matlab/Octave that can be shared by other faculty in and outside our institution. Matlab is free only for students and Georgia Southern, while Octave is free open-source software that has the similar functionality.

Develop assessment methods to measure the impact of these changes on student success and faculty perceptions.

Upon completion of this project, we plan to share course materials with faculty and students inside and outside our institution.

Upon completion of this project, we plan to publish the results from our project.

Upon completion of this project, we plan to expand the number of sections of our OER *Calculus I (for Engineers)*.

Upon completion of this project, we plan to develop OER materials for other STEM classes.

### **Statement of Transformation:**

Description: Revise the course content and replace the current (non-free) textbooks and homework systems for *Calculus I* by existing and newly developed OER course materials for *Calculus I (for Engineers)*.

The primary stakeholders are engineering students who will benefit from course material tailored for their needs, including easily accessible open source content, and from a reduced financial burden. With the new course content, students will be better prepared in their engineering classes.

The secondary stakeholders are mathematics and engineering faculty. With all resources on-line, there will be no delay in acquiring textbooks or homework access codes, so the instruction and assignment can begin on day one of the semester. Additionally, engineering faculty benefit by having more input into the mathematics curriculum, allowing better



prepared engineering students.

The primary impact for students is the opportunity to learn *Calculus I* with course content structured around the specific needs and applications of the engineering curriculum.

The secondary impact for students is reduced financial burden. With 90% of incoming students at Georgia Southern receiving some kind of financial aid in 2014-2015 [7], costs are clearly a major factor affecting the student success. As well, by giving engineering students a better learning experience in *Calculus I*, and they will be better prepared to follow the course sequence to upper level classes in other math courses and courses in their engineering major.

The impact for engineering faculty is having students in their classes who are better prepared in the mathematics they need for their upper level engineering classes.

The impact for mathematics faculty is improved student interest in learning calculus due to the emphasis on topics in their major, and a reduced emphasis on theory in Calculus I in lieu of applications.

The impact for our departments and institution includes easier access and greater enrollment for students in the courses using the free-open source material. As well, with better prepared engineering students, the quality of students and program will be enhanced.

Upon success of our pilot run, our OER *Calculus I (for Engineers)* can be extended to more sections, and adapted to other mathematics courses for STEM majors. This has the potential to greatly enhance students' success in their engineering programs.

### **Transformation Action Plan:**

As a first step to our action plan, team members will be researching existing books for *Calculus for Engineers*, and get input and suggestions from other engineering and mathematics faculty.

The next step is the development of our OER *Calculus I (for Engineers)* course materials. Following the development of course materials, we will create course syllabi, schedules, and materials. This will include course organization, expectations, and goals for new open-source transformation.

Team members will administer standard testing instruments in the semester prior to implementing the new open-source materials.

S. Kersey will be instructor of record for *Calculus I (for Engineers)*. Both R. Haddad and S. Kersey will be involved in the development of the course materials and instruction.

At the final stages of implementation, open-source materials will be stored in central locations and made available to faculty.

**Quantitative & Qualitative Measures:** Upon completion of this project at the end of the Fall 2018 semester, both quantitative and qualitative measures will be applied to assess the efficacy of the transformation to OER Calculus I (for Engineers). We will compare results from classes using traditional Calculus I materials with those using the Calculus I (for Engineers) materials outlined in this proposal. Quantitative measures: Comparison of student performance on mathematical engineering problems. Comparison of pre- and post-content tests for each class, broken down by course learning objectives. Comparison of scores on a common Final Exam. Comparison of DFW (Drop, Fail, Withdrawal) rates between classes. Qualitative measures: Comparison of surveys on student attitudes and opinions regarding course materials. Survey on perceptions of engineering faculty using the new course format.

**Timeline:**

Spring 2018	Attend kick-off meeting, February 26.
	Arrange for two sections of <i>Calculus I (for Engineers)</i> for the Fall 2018 semester. Note: we have already received department and college approvals for this project.
	Review textbooks and course materials on Calculus for Engineers, and select an open source textbook or develop our own.
	Solicit input from engineering and mathematics faculty.
	Develop sample course materials, including homework questions, WeBWorK problems, projects, videos and notes.
Summer 2018	Complete preparation of course materials.
	Prepare course syllabi
	Prepare assessment instruments.
Fall 2018	Carry out instruction in two sections of <i>Calculus I (for Engineers)</i> .

	Give content pre-tests and post-test to students, as well as engineering content tests.
	Analyze the data and prepare reports.

**Budget:**

Dr. Scott Kersey	Compensation for preparation time.	\$5000
Dr. Rami Haddad	Compensation for preparation time.	\$5000
Travel	Kick-off meeting, conference travel, and Supplies.	\$800

**Sustainability Plan:**

After completion of this project, no additional costs are required. Course information and materials will be posted at central locations for faculty to use.

Our OER *Calculus I (for Engineers)* materials will be freely available.

Matlab/Octave Programs and WeBWork problems will be freely available.

Course materials, such as syllabi, weekly schedules, additional notes, modules, programs, videos, and surveys will be made freely available to faculty through university storage, Google drive, Desire2Learn course templates, and faculty web pages.

Team members will maintain point of contact for faculty interested in adoption of our OER *Calculus I (for Engineers)* materials for future years.

Team members will advocate for additional sections of *Calculus I (for Engineers)* in the future semesters.

**Final Semester of** Spring 2017  
**Instruction:**

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DEPARTMENT OF  
MATHEMATICAL SCIENCES

P.O. BOX 8093  
STATESBORO, GEORGIA 30460-8093  
TELEPHONE (912) 478-5390  
FAX (912) 478-0654  
<http://cosm.georgiasouthern.edu/math>

January 9, 2018

To Whom It May Concern:

This letter is in support of the Affordable Learning Georgia Grant submitted by Dr. Scott Kersey and Dr. Rami Haddad. Not only am I enthusiastic about their *Calculus I for Engineers* project, but I am thrilled by the collaboration of faculty in two different departments and colleges.

Dr. Kersey has extensive experience with the WeBWork online homework system from the Mathematical Association of America (MAA). The problems that have already been created and are available in WeBWork are quite useful. However, the ability to create and add additional problems has been an invaluable tool for Dr. Kersey and his students. As opposed to other online homework systems, WeBWork is free of charge to students.

In addition to the online homework system, Drs. Kersey and Haddad plan to develop materials to use with MATLAB. MATLAB is a numerical computing environment specifically designed for scientists and engineers. Georgia Southern has a site license for the software, so there is no cost to students to use the package. This is a considerable savings when compared to the purchase and use of handheld technology, such as a graphing calculator.

Anticipating Drs. Kersey and Haddad's successful implementation of their efforts during Fall 2018, we expect to recruit additional faculty to participate in the program. Faculty from our College of Science and Mathematics as well as engineering faculty from the Allen E. Paulson College of Engineering and Information Technology have expressed a desire to work more collaboratively to ensure engineering students are successful once they leave their mathematics classes and pursue engineering classes. Given the no cost approach to this collaborative effort, I anticipate several faculty who would wish to participate in this approach.

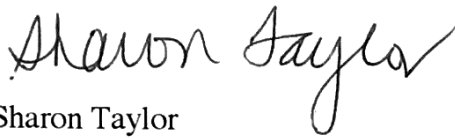
Not only is Dr. Kersey dedicated to lowering costs for students and collaborating with colleagues, he is an excellent instructor. His willingness to try new ideas has led to his nomination for our university award for Excellence in Contributions to Instruction. I believe this combination of dedication to students as well as to teaching speaks very highly of Dr. Kersey and his accomplishments.

Dr. Kersey has already used OpenStax and WeBWork with a previous ALG grant. He is in the process of analyzing data from his pilot implementation in Fall 2017. His prior experience with the online book and homework system, as well as his previous grant work, can only be an asset to this project.

I support Drs. Kersey and Haddad's efforts to transform certain sections of Calculus I to increase success and retention of engineering majors. I especially applaud their efforts to do so at no cost to students.

Please feel free to contact me if you need additional information.

Sincerely,

A handwritten signature in black ink that reads "Sharon Taylor". The signature is written in a cursive style with a large, sweeping flourish at the end.

Sharon Taylor  
Department Chair



MEMORANDUM

TO: Affordable Learning Georgia Textbook Transformation Grants

FROM: Youakim Kalaani, Chair

RE: Support Letter

DATE: January 9, 2018

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This letter is to express my strong support for the Affordable Learning Georgia Textbook Transformation Grant submitted as a joint efforts by two faculty from the departments of Mathematics and the Electrical & Computer Engineering at Georgia Southern University.

If funded, this project will not only transform the way mathematics is being introduced to engineering but it will also help reduce cost by making open-source material available to students. Dr. Rami Haddad who has extensively been involved in STEM related activities is a strong advocate for tailoring mathematic courses to fit the need of engineering students. His renewed and innovative teaching methods have greatly contributed to the success of his students and thus, this project will significantly improve education by making mathematics more meaningful and appealing to engineering students.

I am very pleased and excited about this project and will provide support and resources to achieve the goals stated by the principal investigators of this grant.

Sincerely,

A handwritten signature in cursive script that reads "Youakim Kalaani".

Dr. Youakim Kalaani, Chair  
Electrical and Computer Engineering Department  
Phone: (912) 478-0006  
Email: [yalkalaani@GeorgiaSouthern.edu](mailto:yalkalaani@GeorgiaSouthern.edu)

**Affordable Learning Georgia Textbook Transformation Grants  
Round Eleven  
For Implementations beginning Spring Semester 2018  
Running Through Fall Semester 2018**

**Proposal Form and Narrative**

<b>Submitter Name</b>	Scott Kersey
<b>Submitter Title</b>	Associate Professor of Mathematics
<b>Submitter Email</b>	skersey@georgiasouthern.edu
<b>Submitter Phone Number</b>	912-478-1963912-478-1963
<b>Submitter Campus Role</b>	Proposal Investigator (Primary)
<b>Applicant Name</b>	Scott Kersey
<b>Applicant Email</b>	skersey@georgiasouthern.edu
<b>Applicant Phone Number</b>	912-478-1963
<b>Primary Appointment Title</b>	Associate Professor of Mathematics
<b>Institution Name(s)</b>	Georgia Southern University
<b>Team Members</b>	<p>Scott Kersey, Associate Professor of Mathematics, Department of Mathematical Sciences, <a href="mailto:skersey@georgiasouthern.edu">skersey@georgiasouthern.edu</a></p> <p>Rami Haddad, Assistant Professor of Electrical and Computer Engineering, Department of Electrical and Computer Engineering, <a href="mailto:rhaddad@georgiasouthern.edu">rhaddad@georgiasouthern.edu</a></p>

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers

<b>Sponsor, Title, Department, Institution</b>	Sharon Taylor, Professor and Chair, Department of Mathematical Sciences, Georgia Southern University Youakim Kalaani, Associate Professor and Chair, Department of Electrical and Computer Engineering, Georgia Southern University				
<b>Proposal Title</b>	Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers				
<b>Course Names, Course Numbers and Semesters Offered</b>	Calculus I, MATH 1441, Fall, Spring, and Summer semesters (special sections for Engineering students to be piloted Fall 2018)				
<b>Final Semester of Instruction</b>	Fall 2018				
<b>Average Number of Students Per Course Section</b>	50	<b>Number of Course Sections Affected by Implementation in Academic Year</b>	2	<b>Total Number of Students Affected by Implementation in Academic Year</b>	100
<b>Award Category (pick one)</b>	<input checked="" type="checkbox"/> No-or-Low-Cost-to-Students Learning Materials OpenStax Textbooks <input type="checkbox"/> Interactive Course-Authoring Tools and Software <input type="checkbox"/> Specific Top 100 Undergraduate Courses				
<b>List the original course materials for students (including title, whether optional or required, &amp; cost for each item)</b>	<i>Thomas' Calculus</i> with MyMathLab on line homework system access (\$288.40) or MyMathLab Student Access Kit (\$106.90). Required.				

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers



Requested Amount of Funding	\$10,800
Original Per Student Cost	Calculus I: \$106.90-\$288.40
Post-Proposal Projected Per Student Cost	\$0
Projected Per Student Savings	\$106.90-\$288.40
Projected Total Annual Student Savings	\$10690-\$28840 for 100 students in pilot courses. This may expand to additional course offerings in the future.
Creation and Hosting Platforms Used	<p><b>Microsoft, Apple, Linux Operating Systems:</b> Our course materials and software will run equally-well on these operating systems. While Microsoft and Apple are not free, Linux is free and open source and used by both team members.</p> <p><b>Desire2Learn (D2L, Folio) [4]:</b> Virtual Classroom at Georgia Southern University [1]. This will be used for additional notes, handouts, modules and videos associated with the implementation of this project.</p> <p><b>Google Drive:</b> Some materials may also be stored on the university Google drive for easy access and sharing with faculty.</p> <p><b>WeBWork [2]:</b> Open-source online homework management system with Open Problem Library. The library currently contains over 40,000 mathematics and science problems [3], and includes an editor for writing problems tailored to ones' course. The program was recently installed at our university, and administered by a team member (S. Kersey), who has completed a WeBWork system administrator training course hosted by the Mathematical Association (MAA). This is an open source program that is free for students and the university. WeBWork homework problems for the OpenStax Calculus I textbook were</p>
Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers	

developed by one of the team members (S. Kersey) in a previous ALG grant [8].

**Matlab [5], Octave [6]:** Matlab [5] is a scientific programming language that engineers commonly use and we will use in our course transformation. It is freely available to our students at Georgia Southern on campus and therefore is free to students in our implementation. Students off campus who do not have access to Matlab can use Octave [6], which is open-source and has nearly identical functionality as Matlab; i.e, the programs used in our implementation will work in either Matlab or Octave. Therefore, our implementation is zero-cost for students on or off campus.

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers

## NARRATIVE

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers

## 1.1 PROJECT GOALS

- Develop a new STEM mathematics class *Calculus I (for Engineers)* using zero cost-to-student open education resources (OER) based on input from both engineering and mathematics faculty by replacing two sections of *Calculus I* in the Fall 2018 semester with two sections of our new *Calculus I (for Engineers)* in the Fall 2018 semester, to be taught by the team members.
- Save students money on course materials by replacing the current textbook and homework system with free open source course materials.
- Improve the performance of students in engineering classes that use *Calculus I (for Engineers)* as a prerequisite by providing course content tailored to their needs in their engineering classes.
- Improve the success rate for engineering students in *Calculus I* who take our new sections on *Calculus I (for Engineers)*.
- Improve the perception of engineering faculty on the quality of the mathematics classes and mathematics faculty involved in preparing their students for the mathematics they need in their engineering classes and careers by using our OER *Calculus I (for Engineers)* course materials.
- Include engineering faculty in a control loop decision-making process designed to develop course topics based on students' needs by sharing OER course materials using creative commons (CC) licensing.
- Create new textbook materials, notes, worksheets, videos, assignments and projects based on input from engineering and mathematics faculty.
- Develop new homework problems in WeBWork that can be shared by other faculty in and outside our institution.
- Develop new computer projects in Matlab/Octave that can be shared by other faculty in and outside our institution. Matlab is free only for students and Georgia Southern, while Octave is free open-source software that has the similar functionality.
- Develop assessment methods to measure the impact of these changes on student success and faculty perceptions.
- Upon completion of this project, we plan to share course materials with faculty and students inside and outside our institution.
- Upon completion of this project, we plan to publish the results from our project.
- Upon completion of this project, we plan to expand the number of sections of our OER *Calculus I (for Engineers)*.
- Upon completion of this project, we plan to develop OER materials for other STEM classes.

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers

## 1.2 STATEMENT OF TRANSFORMATION

- Description: Revise the course content and replace the current (non-free) textbooks and homework systems for *Calculus I* by existing and newly developed OER course materials for *Calculus I (for Engineers)*.
- The primary stakeholders are engineering students who will benefit from course material tailored for their needs, including easily accessible open source content, and from a reduced financial burden. With the new course content, students will be better prepared in their engineering classes.
- The secondary stakeholders are mathematics and engineering faculty. With all resources on-line, there will be no delay in acquiring textbooks or homework access codes, so the instruction and assignment can begin on day one of the semester. Additionally, engineering faculty benefit by having more input into the mathematics curriculum, allowing better prepared engineering students.
- The primary impact for students is the opportunity to learn *Calculus I* with course content structured around the specific needs and applications of the engineering curriculum.
- The secondary impact for students is the reduced financial burden. With 90% of incoming students at Georgia Southern receiving some kind of financial aid in 2014-2015 [7], costs are clearly a major factor affecting the student success. As well, by giving engineering students a better learning experience in *Calculus I*, and they will be better prepared to follow the course sequence to upper level classes in other math courses and courses in their engineering major.
- The impact for engineering faculty is having students in their classes who are better prepared in the mathematics they need for their upper level engineering classes.
- The impact for mathematics faculty is improved student interest in learning calculus due to the emphasis on topics in their major, and a reduced emphasis on theory in *Calculus I* in lieu of applications.
- The impact for our departments and institution includes easier access and greater enrollment for students in the courses using our free-open source material. As well, with better prepared engineering students, the quality of students and program will be enhanced.
- Upon success of our pilot run, our OER *Calculus I (for Engineers)* can be extended to more sections, and adapted to other mathematics courses for STEM majors.

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers

This has the potential to greatly enhance students' success in their engineering programs.

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers

### 1.3 TRANSFORMATION ACTION PLAN

- As a first step to our action plan, team members will be researching existing books for *Calculus for Engineers*, and get input and suggestions from other engineering and mathematics faculty.
- The next step is the development of our OER *Calculus I (for Engineers)* course materials.
- Following the development of course materials, we will create course syllabi, schedules, and materials. This will include course organization, expectations, and goals for new open-source transformation.
- Team members will administer standard testing instruments in the semester prior to implementing the new open-source materials.
- S. Kersey will be instructor of record for *Calculus I (for Engineers)*. Both R. Haddad and S. Kersey will be involved in the development of the course materials and instruction.
- At the final stages of implementation, open-source materials will be stored in central locations and made available to faculty.

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers

## 1.4 QUANTITATIVE AND QUALITATIVE MEASURES

Upon completion of this project at the end of the Fall 2018 semester, both quantitative and qualitative measures will be applied to assess the efficacy of the transformation to OER *Calculus I (for Engineers)*. We will compare results from classes using traditional *Calculus I* materials with those using the *Calculus I (for Engineers)* materials outlined in this proposal.

Quantitative measures:

- Comparison of student performance on mathematical engineering problems.
- Comparison of pre- and post-content tests for each class, broken down by course learning objectives.
- Comparison of scores on a common Final Exam.
- Comparison of DFW (Drop, Fail, Withdrawal) rates between classes.

Qualitative measures:

- Comparison of surveys on student attitudes and opinions regarding course materials.
- Survey on perceptions of engineering faculty using the new course format.

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers



## 1.5 TIMELINE

Spring 2018	Attend kick-off meeting, February 26.
	Arrange for two sections of <i>Calculus I (for Engineers)</i> for the Fall 2018 semester. Note: we have already received departmental and college approvals for this project.
	Review textbooks and course materials on Calculus for Engineers, and select an open source textbook or develop our own.
	Solicit input from engineering and mathematics faculty.
	Develop sample course materials, including homework questions, WeBWork problems, projects, videos and notes.
Summer 2018	Complete preparation of course materials.
	Prepare course syllabi
	Prepare assessment instruments.
Fall 2018	Carry out instruction in two sections of <i>Calculus I (for Engineers)</i> .
	Give content pre-tests and post-test to students, as well as engineering content tests.
	Analyze the data and prepare reports.

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers

## 1.6 BUDGET

Dr. Scott Kersey	Compensation for preparation time.	\$5000
Dr. Rami Haddad	Compensation for preparation time.	\$5000
Travel	Kick-off meeting, conference travel, and Supplies.	\$800

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers

## 1.7 SUSTAINABILITY PLAN

After completion of this project, no additional costs are required. Course information and materials will be posted at central locations for faculty to use.

- Our OER *Calculus I (for Engineers)* materials will be freely available.
- Matlab/Octave Programs and WeBWorK problems will be freely available.
- Course materials, such as syllabi, weekly schedules, additional notes, modules, programs, videos, and surveys will be made freely available to faculty through university storage, Google drive, Desire2Learn course templates, and faculty web pages.
- Team members will maintain point of contact for faculty interested in adoption of our OER *Calculus I (for Engineers)* materials for future years.
- Team members will advocate for additional sections of *Calculus I (for Engineers)* in the future semesters.

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers

## 1.8 REFERENCES & ATTACHMENTS

On-line Resources:

1. Georgia Southern: [www.georgiasouthern.edu/](http://www.georgiasouthern.edu/)
2. Webwork: [webwork.maa.org/](http://webwork.maa.org/)
3. Open Problem Library: [webwork.maa.org/wiki/Open\\_Problem\\_Library](http://webwork.maa.org/wiki/Open_Problem_Library)
4. Desire2Learn (Folio): <https://georgiasouthern.desire2learn.com/>
5. Matlab: <https://www.mathworks.com/>
6. Octave: <https://www.gnu.org/software/octave/>
7. National Center for Educational Statistics (NCES): [nces.ed.gov/collegenavigator](http://nces.ed.gov/collegenavigator).
8. S. Kersey and S. Carden, Affordable Learning Grant 277.

See attached letter of support from sponsoring Department Chairs, Dr. Sharon Taylor and Dr. Youakim Kalaani.

Open Education Resources (OER) Development and Implementation for STEM Calculus for Engineers

# Syllabus

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<b>Instructor:</b> Dr. Scott Kersey <b>Office:</b> Math/Physics 2308 <b>Email:</b> <a href="mailto:skersey@georgiasouthern.edu">skersey@georgiasouthern.edu</a>	<b>Section P:</b> MW 9:05-9:55, TR 9:30-10:45 in MP2311 <b>Section I:</b> MW 10:10-11:00, TR 11:00-12:15 in MP2314B <b>Recitation with Grad Assistant:</b> During Wed. meeting times. <b>Office Hours:</b> M 11:00-12:00, TR 12:15-1:00, or by appt.
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**Course Description:** Calculus I is the first of a sequence of courses which present a unified treatment of the differential and integral calculus. Topics include: limits, continuity, differentiation and integration, applications of the derivative and the integral. *Prerequisites: Minimum grade of C in Math 1112 or Math 1113.*

**Living Learning Community (LLC):** This LLC course will emphasize Calculus most useful for students pursuing engineering degrees. Some course work will emphasize engineering tools and applications, and your classmates will comprise students with similar interests. Through coursework, you are encouraged to seek out topics of interest to you and interact with classmates.

**No-Cost Open Education Resources (OER):** This class will utilize open-education resources that are not cost to you. These include:

- Textbook: *APEX Calculus I (free pdf)* ISBN-10: 1719219591, ISBN-13: 978-1719219594
- Homework System: *WeBWork (login in through Folio)*
- Scientific Computation: *Matlab (free on campus, or use the open source package Octave)*
- Course Notes

**Coursework/Assessment:**

- Exams: 100 points each (three midterms on 9-13, 10-11, 11-8, and a final exam)
- Homework (WeBWork): 100 points total
- Quizzes 100 points total
- Projects: Up to 100 points total
- Course Percentage:  $100 * (\text{Points earned}) / (\text{Total Points})$
- Final Grade A (90-100%), B (80-89%), C (70-79%), D (60-69%), F (<60%)

**Attendance Policy:** Attendance will be taken daily, and missed classes will count 2 points off per day on exams following the absence.

**Exam Policy:** No early or late exams given except under extreme circumstances with my prior approval and written documentation.

**Additional Help with Calculus:** Free tutoring is offered in the Math Department (Room 3000) and at the Academic Success Center (912-478-5371, <http://academics.georgiasouthern.edu/success/>). Check for hours.

**University Policies:** Any student who exhibits academic dishonesty in any form will receive penalty ranging from a zero grade or deductions on that assignment or test to a failing grade (F) for the entire course, and will be reported to the University Judicial Officer. For a full discussion of academic dishonesty, and student civility statement, see the Student Guide at <http://deanofstudents.georgiasouthern.edu/conduct/resources/faculty/academic-dishonesty/>. For disability policy, see <http://students.georgiasouthern.edu/disability/>.

# Final Report

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# Affordable Learning Georgia Textbook Transformation Grants

## Final Report

### General Information

**Date: 12/19/2018**

**Grant Round: 11**

**Grant Number: 350**

**Institution Name(s): Georgia Southern University**

**Project Lead: Scott Kersey**

**Team Members:**

**Scott Kersey (Professor, Mathematical Sciences, [skersey@georgiasouthern.edu](mailto:skersey@georgiasouthern.edu))**

**Rami Haddad (Assistant Professor, Electrical Engineering, [rhaddad@georgiasouthern.edu](mailto:rhaddad@georgiasouthern.edu))**

**Course Name(s) and Course Numbers: Calculus I, Math 1441**

**Semester Project Began: Spring 2018**

**Final Semester of Implementation: Fall 2018**

**Total Number of Students Affected During Project: 59**

### 1. Narrative

The goal of this project was to develop a new course *Calculus I for Engineers* to be piloted by during the Fall 2018 semester. The course is designed to better prepare engineering students for the calculus and other mathematical tools needed in their engineering classes; a need expressed by engineering faculty. The course will include engineering related course topics and assignments, and use Open Education Resources (OER) to reduce the financial burden on students. *Calculus I for Engineers* will be implemented as a special section of the mathematics course *Calculus I*, which is a required course for engineering students.

In the final implementation, students used the open WeBWorK homework system combined with APEX calculus at no cost to students. Most of the WeBWorK problems for Calculus I have been written (by S. Ault at Valdosta State University). In addition, some additional problems were created for other sections in the book, and some new problems used to text students on



Matlab/Octave, which was used in the course. Based on a survey taken given during the semester, students appreciated the free OER materials and viewed them as effective. The final grades reflected their effort and performance on homework.

In addition to homework and lab work in Matlab/Octave, students completed two projects from a list of choices, or of their choice. Originally, the plan was to get a list of problems from engineering faculty, which turned out to be problematic. To overcome this problem, students were asked to seek out their own problem and pair with an engineering faculty member. Student projects were highly creative and provided a motivational aspect to the course. For future implementations, problems from their projects will be used as well as others written by the PI.

Based on data provided by the university, the impact of the implementation includes a higher average course grades and less withdrawals than the traditional course. In this sense the transformation was a success, and will be continued in future semesters by the PI. In the Spring, the PI will extend the implementation to Calculus II. During this time, the PI will be developing more problems for WeBWork, which will be shared with the ALG community at a later time. It is expected that this will include more problems for APEX calculus, engineering mathematics problems, and Matlab/Octave problems written in WeBWork.

The impact of the transformation at my school includes some interest in the improved success rate. It affects my instruction in designing my Calculus classes in the future. It impacts students by an improvement of performance, and providing them a mathematics class that better coincides with their intended majors. Through this experience, the PI has a better understanding of what motivates students and how to help them succeed using open course materials with applications. In future implementations, I will focus on improving interactions with engineering faculty. As well, there are additional help resources in the online homework I intend to use in the future.

## 2. Quotes

- This was my 1<sup>st</sup> free course materials class and I was so Thankful! This was a huge burden off my shoulders because I had to purchase more books.
- Free course materials were extremely helpful this semester.
- Thank you for such an amazing calculus class. You are a great professor and the way you teach is extremely helpful! Your class was by far one of my best this semester.

## 3. Quantitative and Qualitative Measures

### 3a. Uniform Measurements Questions

Student performance improved from previous semesters by the same instructor (PI) and was significantly higher than other sections of Calculus I. In particular, the DWF rate was 10%

compared to 14%, and the pass rate (A, B or C) was 77% compared to 63% for other sections of Calculus I.

### 3b. Measures Narrative

Data concerning DWF rates and student success was provided by my university, and may be reported at a later date.

I have attached s survey used to assess student perceptions on their experience using OER course materials and other aspects of teaching and learning.

### 4. Sustainability Plan

- Free WeBWork problems will be made available in the future. This will include problems for the calculus textbook, as well engineering and matlab applications. These will be stored in a zip file, and shared with the ALG community and my university faculty, as appropriate.

### 5. Future Plans

- I will be teaching Calculus using the same materials in future semester, starting next Spring.
- I am considering research based on the ALG project. Currently, I have two papers in preparation based on a previous ALG project.

### 6. Description of Photograph

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