Affordable Materials Grants, Round 19:

Transformation Grants

(Spring 2021-Spring 2022)

Proposal Form and Narrative

# Notes

* The proposal form and narrative .docx file is for offline drafting and for our review processes. Submitters must use the online Google Form for proposal submission.
* The only way to submit the official proposal is through the online Google Form. The link to the online application is on the [Round 19 RFP Page](https://www.affordablelearninggeorgia.org/about/rfp_r19).
* The italic text provided below is meant for clarifications and can be deleted.

The Round 18 Kickoff will include an asynchronous training module, required for all team members to complete, followed by the synchronous Kickoff Meeting on March 26, 2021 from 1pm-4pm. At least two team members from each awarded team (unless the award is for one individual) are required to attend the synchronous Kickoff Meeting.

# Applicant and Team Information

*The* ***applicant*** *is the proposed Project Lead for the grant project. The* ***submitter*** *is the person submitting the application (which may be a Grants Officer or Administrator). The submitter will often be the applicant—if so, just list leave the submitter blank.*

| Requested information | Answer |
| --- | --- |
| Institution(s) | Georgia Institute of Technology |
| Applicant name | David L. Hu |
| Applicant email | [hu@me.gatech.edu](mailto:hu@me.gatech.edu) |
| Applicant position/title | Professor |
| Submitter name | Lea Brooks |
| Submitter email | [lea.brooks@osp.gatech.edu](mailto:lea.brooks@osp.gatech.edu) |
| Submitter position/title | Contracting Officer |

Please provide the first/last names and email addresses of all team members within the proposed project. Include the applicant (Project Lead) in this list. Do not include prefixes or suffixes such as Ms., Dr., Ph.D., etc.

| Team member | Name | Email address |
| --- | --- | --- |
| Team member 1 | David L. Hu (Project Lead) | [hu@me.gatech.edu](mailto:hu@me.gatech.edu) |
| Team member 2 | David S. Ancalle-Reyes | [dreyes34@gatech.edu](mailto:dreyes34@gatech.edu) |
| Team member 3 | Chaohua Ou | [cou@gatech.edu](mailto:cou@gatech.edu) |
| Team member 4 | TBD, student assistant |  |
| Team member 5 | TBD, student assistant |  |
| Team member 6 | TBD, student assistant |  |

If you have any more team members to add, please enter their names and email addresses in the text box below.

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# Project Information

| Requested information | Answer |
| --- | --- |
| Priority Category / Categories | * Collaborative Projects with Professional Support * Student Participation in Materials Evaluation and/or Development |
| Requested Total Amount of Funding  *$30,000 maximum total award per grant* | $30,000 |
| Final Semester of Project | Spring 2022 |
| Using OpenStax Textbook? | Yes |

# Impact Data

Please fill in the data below with impact data in below with *one course taught by one instructor* in each table, and only include courses and instructors that are specifically part of the scope of this grant proposal. Add or remove tables as needed. **Please only put a single averaged or totaled (as appropriate) number in each box. Do not put ranges or mathematical equations in any of these boxes.**

For a multi-course project, if a significant amount of students are assumed to take courses in a sequence and only one textbook is used for these courses, please take this into account in your total *(i.e. only include that book in the first course they would purchase it for OR adjust the number of students affected. Please explain in the notes section if making such adjustments).*

## Course 1

| Row # | Requested information | Answer |
| --- | --- | --- |
| N/A | Course title and number | ME 3340 – Fluid Mechanics |
| N/A | Course instructor | David L. Hu |
| 1 | Average number of students enrolled per section | 50 |
| 2 | Average number of affected course sections scheduled in a summer semester | 5 |
| 3 | Average number of affected course sections scheduled in a fall semester | 5 |
| 4 | Average number of affected course sections scheduled in a spring semester | 5 |
| 5 | Total number of course sections scheduled in an academic year | 15 |
| 6 | Total number of student section enrollments per academic year | 750 |
| 7 | Original required commercial materials  *Include each title, author, price for a new copy purchased from either your campus bookstore, the publisher, or Amazon, and a URL to the book showing the price.* |  |
| 8 | Original cost per student section enrollment  *Add up the cost of all materials in row 7.* | $200.00 – average cost of a math refresher textbook (Advanced Engineering Mathematics by Dennis Zill) |
| 9 | Average post-project cost per student section enrollment | 0 |
| 10 | Average post-project savings per student section enrollment  *Subtract row 9 from row 8.* | $200.00 |
| 11 | Projected total annual student savings per academic year  *Multiply row 10 and row 6.* | $150,000 |

# Narrative Section

## 1. Project Goals

The purpose of this project is to prepare and support undergraduate students to succeed in upper-level engineering courses by designing, developing, and delivering an online short course on Mathematics. This free and open course will review the math topics essential for upper-level engineering courses, and will consist of video lectures and graded assessments delivered through an online platform. This project can be summarized by the following major goals:

1. We will develop video lectures and content to teach the essentials of mathematics for engineering students.
2. We will develop assessments that focus on engineering applications of mathematics concepts, to test students not on their ability to memorize theorems, but on their ability to apply this knowledge to solve basic engineering problems.
3. We will deliver this course online, making it freely accessible to all engineering students within and beyond Georgia Tech.
4. We will assess the effectiveness of this course on student learning through learning analytics, student surveys, student learning outcomes, as well as feedback from faculty that teach engineering courses.
5. We will use the feedback collected from both the faculty and students to continue developing and improving this course.

## 2. Statement of Transformation

**Problem Statement**

Over the last two decades, students have been showing a slow but steady decline in their ability to apply their calculus background to engineering classes. Faculty at the Georgia Tech School of Mechanical Engineering noticed this trend and administered a survey to assess students’ calculus background in Spring 2020. They found that many students were unable to solve problems that were commonly assumed to be prerequisites for taking engineering courses. For example, we consider the course ME 3340 – Fluid Mechanics, a required course for mechanical engineering students. In the end-of-semester evaluations for the upper-level engineering course ME 3340 taught by Dr. David Hu, students rated themselves a 3.6/5.0 average on “level of preparation to take the course,” despite rating the professor a 4.5/5.0 on overall ability as an instructor. Faculty have discussed that due to the available lecture time in a semester, the class cannot be restructured to review prerequisite materials. At the same time, instituting requirement for a math course such as Engineering Mathematics (currently taught as a 2-semester graduate course at Georgia Tech with no undergraduate equivalent) would result in additional credit-hours and tuition increase to students.

**Transformation Statement**

To address this issue, we will create a free, and open math course that will prepare students with the knowledge and skills to succeed in upper-level engineering courses. Students who successfully complete this course will have mastered the prerequisites needed for upper-level engineering courses, allowing them to focus their attention on the central topics of each course, and leading to an improvement in their overall performance and satisfaction in their courses.

Our math lectures will be unique in that they will be taught from an engineering perspective and with an engineering focus, as such, applications in engineering will be emphasized in the lectures, while keeping in mind that the goal is to improve students’ math background, not teach them new engineering material. We will also create the assessments of this course. In a similar fashion, our assessments will focus on not only testing a student’s math skills, but rather their application of those skills in engineering. We do not plan to structure our math primer like an in-person class. Instead, we plan to make the most out of our online format by focusing on pedagogical techniques related to online education. Examples include short video times, structuring the videos as conversations rather than one-person lectures, and taking advantage of visual resources to show the applications of math. Through this course, we plan to help students succeed in upper-level engineering courses and improve their grades and performance at no extra cost.

While this course is initially aimed at students in the Mechanical Engineering program at Georgia Tech, the goal of the project is for the math primer to be accessible and useful for all engineering students studying in Georgia and beyond. We will pursue partnerships with faculty and departments in other schools to deliver this course to their students. An example of one such partnership is with Kennesaw State University, as one of the team members for this proposal, David Ancalle, is a full-time faculty at their Department of Civil and Environmental Engineering.

## 3. Action Plan

**Team Member Roles**

Our team consists of the following members.

1. **Dr. David Hu** is a professor of Mechanical Engineering at Georgia Tech, and is the instructor of record for ME 3340 – Fluid Mechanics, one of the upper-level mechanical engineering courses. Dr. Hu holds a PhD in Mathematics from MIT, has taught at Georgia Tech for 12 years, and has won the Science Communication Award form the American Institute of Physics. Dr. Hu will leverage his combined background in mathematics, engineering, and science communication to lead the development of our math primer. Dr. Hu’s tasks can be summarized as follows:  
   1. Preparation and development of the course structure, including organizing the course into modules. (10 hrs.)
   2. Preparation of the course materials, including overseeing the development of the “script” for the lecture videos and ensuring the accuracy of their content. (20 hrs.)
   3. Development of the lecture materials, including recording lectures. (50 hrs.)
   4. Preparation of the course assessment, including planning the assessment structure and overseeing their development, as well as ensuring their content quality and accuracy. (20 hrs.)
   5. Overseeing the development of the course delivery platform. (5 hrs.)
   6. Overseeing the course once it launches, including addressing student engagement and performance and end-of-course surveys. (5 hrs.)
   7. Establishing partnerships with faculty in other Georgia Tech departments and in other Georgia universities to facilitate the delivery of this course in a free and open format to students from all universities.
2. **David S. Ancalle-Reyes** is a full-time instructor at Kennesaw State University, as well as a PhD student at Georgia Tech. He has taught upper-level engineering courses at KSU for the past four years, and was previously a math teacher for high school students. In addition, he teaches fully-online courses at Gwinnett Technical College, and has won several student-nominated teaching awards. Mr. Ancalle is a licensed professional engineer, and will leverage his engineering and teaching background to assist in the development of our math primer. Mr. Ancalle’s tasks can be summarized as follows:  
   1. Assisting in the preparation and development of the course structure, including organizing the course into modules. (10 hrs.)
   2. Preparation of the course materials, developing the “script” for the lecture videos. (40 hrs.)
   3. Development of the lecture materials, including recording lectures and overseeing their technical production such as audio/video editing. (80 hrs.)
   4. Preparation of the course assessment, including planning the assessment structure and developing assessment questions and solutions. (50 hrs.)
   5. Assisting in the development of the course delivery platform. (10 hrs.)
   6. Managing the delivery and response of end-of-semester surveys and following up with students after their first semester of an upper-level engineering course to assess the course’s success. (10 hrs.)
   7. Establishing partnerships with faculty at other universities to facilitate the delivery of this course in a free and open format to students from all universities.
3. **Dr. Chaohua Ou** is the Assistant Director of Learning & Technology Initiatives at the Georgia Tech Center for Teaching and Learning. Dr. Ou is the campus design champion for Affordable Learning Georgia (ALG) and has successfully completed an ALG transformation project before. She has worked with faculty and students across all disciplines to improve the delivery and accessibility of open online courses. Dr. Ou will leverage her experience developing learner-focused, open-access, and online course materials to manage the deployment, distribution, and accessibility of our math primer. Her tasks can be summarized as follows:  
   1. Overseeing the design and development of the delivery platform for this course (40 hrs.)
   2. Working with the Center for Teaching and Learning to ensure the open access of this course. This includes planning for bandwidth costs, site usage, and site access. (40 hrs.)
   3. Working with the Center for Teaching and Learning to ensure that the course reaches its intended audience. This includes promoting the course through Georgia Tech communications media, and establishing partnerships with faculty at Georgia Tech. (20 hrs.)
4. **Student Assistant** (to be named). The student will assist Dr. Hu in the content-portion of the course. This includes tasks such as grading assessments, assisting in developing solutions, and assisting in preparing written materials and reports. (200 hrs.)
5. **Student Assistant** (to be named). The student will assist Mr. Ancalle in the media-portion of the course. This includes video recording, editing, and production. (200 hrs.)
6. **Student Assistant** (to be named). The student will assist Dr. Ou in the web development portion of this course. This includes working on the front-end of this course ensuring that the online delivery platform is accessible and easy to navigate. (200 hrs.)

**Plan for Creation of New Course Materials**

Content

After the general outline of the course is designed, which includes establishing topics to be covered and amount of time to dedicate to each topic, Dr. Hu, Mr. Ancalle, and the student assistants will prepare a script for each lecture video to be recorded. The lecture videos will be framed as a conversation, so that one person plays the role of the teacher and one the role of the student. As part of developing a script for each lecture, written examples will be developed and carefully worked through in order to present the best solution for each type of problem to be presented.

Videos

Each lecture will be recorded using film cameras and document cameras. Document cameras will focus on the written content of the lectures while film cameras will focus on the lecturers. Videos will be edited using a non-linear video editor and the recordings will be mixed with open-source figures and videos that will be either developed by the team members or obtained from external open resources with the appropriate licensing. Videos will be rendered and exported in mp4 format.

Written Materials

As part of the development of each lecture script, a series of notes will be put together to aid the student in following the course. At present, we are discussing the feasibility of including these notes in the final deployment of the course, as we’d like to encourage students to take their own notes which will be more helpful to them when taking future courses.

Online Delivery

For students at Georgia Tech, the course will be available through the university’s learning management system (LMS), Canvas. They can self-enroll in the course and the self-enrollment is a one-click process through a link provided. Once they are enrolled, they will be able to access the course materials and assessment within the course site.

We will also make the course materials accessible to non-Georgia Tech students. Canvas offers the feature of enabling a course for public access.

For instructors who are not affiliated with Georgia Tech and wish to offer the course in their own LMS, we will offer them a copy of the course exported from Canvas. Canvas exports courses in the IMS Common Cartridge format, which will allow instructors to import the course package into their LMS.

We will provide all the above course enrollment, course public access, and course package requesting information on a dedicated website.

Licensing of Created Materials

All of our created content for this course will be made available to the public under a Creative Commons Attribution License (CC-BY).

**Open Access Plan**

We plan to host our newly created materials in the Affordable Learning Georgia repository. In addition, we will make these materials freely accessible through a repository provided by the Georgia Institute of Technology.

## 4. Quantitative and Qualitative Measures

The performance of our math primer will be gaged through in-course and post-course measures. In-course measures refer to effectiveness assessments that occur while the student is taking our math primer. As the goal of this math course is to improve student performance in their upper-level engineering courses, then post-course assessments are necessary to understand the effectiveness of our math primer. These will be assessed through a combination of student and faculty feedback. A trial deployment will be made during Summer 2021, where an in-person, synchronous version of the math primer will be taught to two students who plan to take ME 3340 in the Fall semester. We will use these student’s feedback and experience during the Fall semester to refine and improve the development of our course. During the first semester of official deployment for this online course, we will use ME 3340 – Fluid Mechanics as the control course, in collaboration with faculty that teach the course.

In-course measures include:

1. Math primer availability and interest, to be measured by comparing the number of students who sign-up for our math primer to the number of students registered for ME 3340 for the following term.
2. Math primer retention, to be measured by comparing the number of students to complete the primer to the total number of students who registered in the primer.
3. Effectiveness of lecture content to be measured through graded assessments during the first deployment of the math primer.
4. Effectiveness and usage of lecture videos to be measured through video analytics, such as percentage of lecture videos watched, average continuous watch time, number of times a lecture video is watched by the same student, and studying the relationship between these numbers and the overall performance of students in our graded assessments.
5. Student satisfaction to be measured by administering an end-of-course survey to students where they can denote their thoughts about the primer, including possible ways to improve it.

Post-course measures include:

1. Course effectiveness to be measured by looking at the number of students who took our math primer and enrolled in ME 3340. This number will be compared to the number of students who completed ME 3340 (i.e., who did not withdraw from the course).
2. Course effectiveness to be measured by comparing the average grades in ME 3340 of students who took our math primer vs. students who didn’t.
3. Student assessment to be measured by administering end-of-semester surveys as well as select interviews with willing students to discuss how the math primer prepared (or failed to prepare) them for ME 3340.
4. Student success to be measured by evaluating the official Georgia Tech end-of-semester surveys for ME 3340, with particular attention to how students rated themselves on “preparation for the course”.
5. Faculty assessment to be measures by discussing student engagement and preparation with ME 3340 faculty at the beginning, middle, and end of the semester.

Upon success of the first semester, we will use our feedback to improve the course and then aim towards general 3000-level mechanical engineering courses at Georgia Tech. Once successful, we will once again improve our course based on feedback and evaluations and continue expanding to other departments within Georgia Tech and other schools.

## 5. Timeline

Summer 2021

* Initial course planning and development – selection of topics and organization of course
* Review and selection of open textbooks for reference use throughout the course
* Preparation of first draft of written materials
* Advertisement for in-person trial run of math primer, selection of two volunteer students to take the course
* In-person trial run of the math primer
* Collecting data from the course and student satisfaction surveys
* Submission of Status Report to ALG (August 2021)

Fall 2021

* The students who took the in-person math primer trial will take ME 3340 during this semester. We will collect end-of-semester data of the students’ performance.
* Refining of course outline and written materials based on student feedback
* Development and writing of graded assessments and their solutions
* Recording and producing lecture videos
* Development and design of the online learning environment
* Advertisement for the official math primer to Georgia Tech Mechanical Engineering students who plan to take ME 3340 in the Spring.
* Deployment of the math primer (December 2021)
* Submission of Status Report to ALG (December 2021)

Spring 2022

* Refining the course outline, written materials, and lecture videos based on student feedback
* Collecting end-of-semester data of the student’s performance.
* Collecting student satisfaction surveys and interview
* Interviewing ME 3340 faculty
* Second deployment of the math primer, now available to all mechanical engineering students (May 2022).
* Submission of final report to Affordable Learning Georgia (May 2022)

## 6. Budget

* Release time for Dr. Hu - $5,000
* Release time for Dr. Ou - $5,000
* Salary for David Ancalle - $5,000  
  Mr. Ancalle will be hired to work for 200 hours during Summer 2021, Fall 2021, and Spring 2022 at a rate of $25/hr.
* Salary for student assistant (content development) - $5,000  
  The student assistant for content development will be hired to work for 200 hours during Summer 2021, Fall 2021 and Spring 2022 at a rate of $25/hr.
* Salary for student assistant (media production) - $5,000  
  The student assistant for media production will be hired to work for 200 hours during Fall 2021 and Spring 2022 at a rate of $25/hr.
* Salary for student assistant (web development) - $5,000  
  The student assistant for web development will be hired to work for 200 hours during Fall 2021 and Spring 2022 at a rate of $25/hr.

## 7. Sustainability Plan

*Transformation Grants should have a lasting impact on the course for years to come. In order for this to happen, a Sustainability Plan needs to be in place after the end of the project. Please include here your plans for offering the course in the future, including:*

The content and assessment materials will be housed in the learning management system and an open-access web site at Georgia Tech, where they are easy to maintain, modify, and update. The course will continue to be improved and maintained beyond the Spring 2022 term by Dr. Hu and Mr. Ancalle, with support from the Center for Teaching and Learning, and the School of Mechanical Engineering.

Upon successful deployment of the course finalizing the ALG grant period, the team members will seek to establish partnerships with other departments within Georgia Tech and with other schools in the University System of Georgia to increase the reach of the course. Future plans include applying to Continuous Improvement Grants to support further development of the course.

We will develop a workshop for faculty at Georgia Tech to share our experiences with the design and development of the open educational resources (OER). We will also submit a proposal to a national or international conference to share our experiences with the OER community. We will also develop a workshop in conjunction with the Department of Civil and Environmental Engineering at Kennesaw State University to share our experience and promote this course.

# Creative Commons Terms

I understand that any new materials or revisions created with ALG funding will, by default, be made available to the public under a Creative Commons Attribution License (CC-BY), with exceptions for modifications of pre-existing resources with a more restrictive license.

# Accessibility Terms

I understand that any new materials or revisions created with Affordable Learning Georgia funding must be developed in compliance with the specific accessibility standards defined in the [Request for Proposals](https://www.affordablelearninggeorgia.org/about/rfp_r18).

# Letter of Support

*The Department Chair from the corresponding project, or the Department Chair’s direct report such as the Dean or Provost, must provide a signed Letter of Support for the project. This letter should acknowledge the following:*

* *The department will provide support for fund disbursement in correspondence with the Grants/Business Office.*
* *The department approves of the work on the proposal by the applicant(s).*
* *The department acknowledges the sustainability of the use of these affordable resources after the grant work is complete.*

*In the case of multi-institutional affiliations, all participants’ institutions must provide a letter of support.*

*Please provide the name and title of the department chair (or other administrator) who provided you with the Letter of Support.*

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| --- |
| *Samuel Graham, Department Chair and Professor* |

# Grants or Business Office Letter of Acknowledgment

*Institutional Grants/Business Offices will be responsible for fund disbursement, often in correspondence with the Department Chair, including expense and travel reimbursement. Applicants will need to provide a short Letter of Acknowledgment stating that the Grants/Business Office knows about the applicant’s intent to apply for an Affordable Materials Grant. Either the Department Chair or the Project Lead can work with the Grants/Business Office to get this signed letter.*

*In the case of multi-institutional affiliations, all participants’ institutions must provide a letter of acknowledgment.*

*Please provide the name and title of the grants or business office representative who provided you with the Letter of Acknowledgment.*

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| --- |
| *Lea Brooks, Assistant to General Manager Contracting Officer* |