



Textbook Transformation Grants, Round Sixteen  
(Spring 2020 – Spring 2021)  
Proposal Form and Narrative

### Notes

- The proposal form and narrative .docx file is for offline drafting and review. Submitters must use the InfoReady Review online form for proposal submission.
- The only way to submit the official proposal is through the online form in Georgia Tech's InfoReady Review. The link to the online application will be on the [Round 16 RFP Page](#).
- The italic text provided below is meant for clarifications and can be deleted.

### Applicant, Team, and Sponsor Information

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Applicant Position/Title	Assistant Professor
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Submitter Email	lli19@kennesaw.edu
Submitter Phone #	470-578-2344
Submitter Position	Assistant Professor

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.

	Name	Email Address
Team Member 1	Lin Li	<a href="mailto:lli19@kennesaw.edu">lli19@kennesaw.edu</a>
Team Member 2	Robert S. Keyser	<a href="mailto:rkeyser@kennesaw.edu">rkeyser@kennesaw.edu</a>
Team Member 3	Meng Han	<a href="mailto:mhan9@kennesaw.edu">mhan9@kennesaw.edu</a>

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

N/A

Please provide the sponsor's name, title, department, and institution. The sponsor is the provider of your Letter of Support.

*Department Chair: Gregory Wiles, Associate Professor  
Department of Systems and Industrial Engineering*

## Project Information and Impact Data

<b>Priority Category / Categories</b>	<i>Developing No-Cost-to-Student Learning Materials for Systems and Industrial Engineering Undergraduate Simulation and Engineering Application Courses.</i>
<b>Requested Amount of Funding</b>	\$11,800
<b>Course Names and Course Numbers</b>	ENGR 1100: Survey of Engineering Applications from Mathematics IET 4451: Systems Simulation
<b>Final Semester of Project</b>	<i>Spring 2021</i>
<b>Average Number of Students Per Course Section Affected by Project</b>	40
<b>Average Number of Sections Affected by Project in One Academic Year</b>	4
<b>Total Number of Students Affected by Project in One Academic Year</b>	160
<b>Average Number of Students Affected per Summer Semester</b>	0
<b>Average Number of Students Affected per Fall Semester</b>	80
<b>Average Number of Students Affected per Spring Semester</b>	80

<b>Original Required Commercial Materials</b>	<p>(1) <i>Introductory Mathematics for Engineering Applications</i>, 1<sup>st</sup> Edition  Authors: Kuldip Rattan &amp; Nathan Klingbeil  Publisher: Wiley, 2014  ISBN-13:978-111814180</p> <p>(2) <i>MATLAB: An Introduction with Application</i>, 6<sup>th</sup> Edition.  Author: Amos Gilat  Publisher: Wiley, 2014  ISBN-13: 978-111862986</p> <p>(3) <i>Simulation with Arena</i>, 6th Edition  Authors: W. David Kelton, Randall P. Sadowski, and Nancy B. Zupick  Publisher: McGraw-Hill, 2015  ISBN: 978-0-07-340131-7</p>
<b>Total Price of Original Required Materials Per Student</b>	<p>\$153.90 -ENGR1100</p> <p>\$204.75 -IET4405</p> <p>\$358.65 total</p>
<b>Post-Project Cost Per Student</b>	\$0
<b>Post-Project Savings Per Student</b>	\$358.65 (assuming students purchase a used book)
<b>Projected Total Annual Student Savings Per Academic Year</b>	\$28,692.00
<b>Using OpenStax Textbook?</b>	No

Table 1. Student Enrollment Summary & Projection

Course	Projected 2020-2021 Enrollment		
	Fall 2020	Spring 2021 *	Total
ENGR 1100	40	40	80
IET 4451	40	40	80

- ENGR1100 is a required lower-level undergraduate course in Southern Polytechnic College of Engineering and Engineering Technology (SPCEET) at Kennesaw State University.
- IET 4451 are required fourth-year undergraduate course in Southern Polytechnic College of Engineering and Engineering Technology (SPCEET) at Kennesaw State University in their respective majors

\* ENGR1100 used to be offered only once per year in department of Systems and Industrial Engineering (ISYE). However with the significant growth in its undergraduate program, the department is planning to offer this course every Fall and Spring semester. We project the enrollment for Spring 2021 based on the ISYE enrollment growth. IET 4451 is typically offered twice per year in department of Systems and Industrial Engineering (IET).

## Narrative Section

### 1. Project Goals

We propose to develop the two undergraduate engineering courses using no-cost-to-students learning materials for the Bachelor of Science degree in Industrial and Systems (ISYE) program and Industrial Engineering Technology (IET) Bachelor degree program of the Department of Systems and Industrial Engineering at Kennesaw State University.

- ENGR 1100: Survey of Engineering Applications from Mathematics is a required 4-credit undergraduate course that was created to increase student retention, motivation, and success in engineering through an application-oriented introduction to engineering mathematics. This course does not replace other math courses, but provides a survey of the most significant math topics used in the core freshman and sophomore-level engineering courses. All these fundamental math topics will be presented within the context of engineering applications, and reinforced through examples of their use in the core engineering courses. This course also provides an introduction to the engineering analysis software MATLAB, which is a high-level language with an interactive environment used by millions of engineers and scientists worldwide. Application of the software is integrated with each course assignment.
- IET 4451: Systems Simulation is a required 3-credit hour undergraduate courses in the Industrial Engineering Technology major. Students use ARENA, a stochastic event-based, PC-based graphical simulation program to create virtual equivalents of real-world processes. Students create and apply a series of simulation models to statistically analyze discrete and continuous systems in the areas of manufacturing, banking, retail, transportation, and others. Techniques such as sequencing, separation, batching, entity transfer, data collection, animation, process analysis, and process optimization are used to improve efficiency and effectiveness.

Our proposed project can better support the ISYE and IET program growth by achieving the following goals, 1) reduce the financial burden imposed by the high cost of textbooks, 2) develop free and effective open-access learning materials that have equivalent or better efficacy than traditional textbooks, 3) initiate the first ALG effort in IET program as most of the courses are currently based on traditional textbooks. The success of this project will promote the visibility of ALG in the department and encourage other instructors join this effort, which subsequently helps reshape education in the domain and improve the success of our students in both ISYE and IET program.

### 2. Statement of Transformation

The proposed ENGR 1100 is a 4-credit undergraduate course that provides a survey of the most significant math topics used in the core freshman and sophomore-level engineering courses. These math topics are reinforced through examples of their use in engineering applications, which are implemented through MATLAB programming to provide students hands-on learning experience. The original course design requires two textbooks, one on mathematics for engineering, the other on MATLAB programming. These two traditional textbooks are not only costly, but also limited in terms of their effectiveness in facilitating student learnings compared to other interactive online materials.

In addition, due to the evolving nature of the MATLAB programming language, the textbooks used in the proposed course is updated frequently, which negatively decreases its resale value. The goal of our transformation is to develop the proposed courses from the scratch with no-cost-to-students learning materials that offer equal or higher educational effectiveness

For IET 4451, we are currently using a free software package, the student version of Arena. Heretofore, we have been using the textbook that corresponds to each version of this software, which is a required textbook for this course. Dr. Keyser has taught this course for six years and is qualified to develop course notes and tutorial videos to replace the previously required textbook in order to ease the financial burden to students. Further, we have seen evolving technology in relation to the Arena software. During the past six years, there have been three updated versions of this software, each requiring a new textbook to keep up with the software changes. We have only used Arena v15.10 for one year. A fourth updated version of Arena software, v16.0, is about to hit the market.

This project aims to replace the textbooks used in the ENGR1100 and IET 4451 with no-cost-to students learning materials that offer equal or higher educational effectiveness. We believe the proposed transformation is an economical and viable solution to address the challenges imposed by the traditional textbook model for the reasons stated below,

- First, the learning materials for both courses are widely and readily available on the World Wide Web today, and many of these resources are publicly accessible, free, or with an open license to use. These materials include open and free tutorials, videos, test banks, notes and services. For example, many of math-related topics such as trigonometry, systems of equations, and differential equations are supported by the open source communities such as Khan Academy and GALILEO. The MATLAB programming tutorials can easily be found on [www.mathworks.com](http://www.mathworks.com).
- Second, the online content is generally more interactive. The interactive content not only engages students better, but also improves their learning experience. For example, the differential equation topics covered in this course can be the Interactive Differential Equations (<https://media.pearsoncmg.com/aw/ide/idefiles/navigation/main.html>) offers a collection of interactive differential equations tools designed to help students visualize the mathematics through animation.
- Third, developing and assembling a set of learning materials (i.e. tutorial videos that demonstrate the concepts in each learning module) allow instructors to better align the course contents with the learning outcomes of the courses and our ISYE and IET

program. Students have complained that the textbook is difficult to follow. Using materials created by the instructor will better serve the learning outcomes of the course.

- Fourth, the current textbook used in this course is not only expensive, but also not on par with the latest updates. As soon as the new Arena and MATLAB software version is released, the instructions in the textbook become fairly obsolete. The same concepts are included in the newer editions; however, the way we use these concepts differ from one edition of the textbook (and accompanying software version) to the next. Therefore, the instructor needs to include the latest and current best practice in presenting new concepts in the construction of simulation models.
- Last but not the least, our team members are well prepared for the proposed transformation. Dr. Li has been the instructor for ENGR1100 for three semesters, and Dr. Keyser has been the instructor of IET 4451 for six years (both Fall and Spring semesters each year). Both of them are not only subject matter experts, but also dedicated educators who have excellent teaching evaluations. Dr. Han participated three ALG grants (round 10 #334, round 12 #386, and round 13 #422) and has extensive experiences in designing no-cost-to-student learning materials, and he will coordinate this project. The team will work closely together on all transformation efforts and further increase the cost-saving benefits to the students in IET and ISYE programs.

### **Impact of the Transformation/Development**

The impact of this transformation effort will be significant. Under our estimates, approximately 160 students will benefit from the no-cost learning material each year for these two courses. The proposed project is expected to save students approximately \$28,692 in textbook cost. This proposed project is also important as it initiates the effort of creating no-cost-to-students learning materials in both the IET and ISYE programs at Kennesaw State University. Even though the no-cost-to-students learning materials have been widely adopted in other computer- and technology-related programs, most of the required courses in the IET and ISYE programs still heavily depend on traditional high-cost textbooks. The success of this project will increase the academic community's awareness of no-cost-to-student learning materials and encourage other faculty members or instructors in the Systems and Industrial Engineering field to join the ALG mission.

Moreover, the learning materials developed in this proposal will be made available to the public and can be easily adopted by other programs or intuitions who want to lower the cost of education to their students. We believe that our experience gained in this transformation project would be beneficial to the academic community. In summary, we believe the proposed project will have a positive impact on students' retention, progression, and graduation at the program, department, and institution levels.

### **3. Transformation Action Plan**

With a coordinated effort, our team of investigators plans the following activities to develop the proposed courses using completely no-cost learning materials:

- Develop the course content in units of learning modules.
- Research and identify no-cost readings for each of the learning modules in each course. The reading list includes both required readings and optional readings, all of which will be publicly accessible, free to use, or openly licensed.
- Record tutorial videos that introduce new concepts and demonstrate how to create models incorporating these new concepts.
- Closed-captioning will be available in the recorded videos.
- Develop all assignments and project materials to replace those in the textbook.
- Develop major assessments such as Midterm and Final Exams.

The responsibilities of investigators are described as follows:

- **Primary Investigator:** Dr. Lin Li.
  - Course: ENGR 1100.
  - Responsibilities: project lead; coordinator, subject matter expert and course developer, instructor of record.
- **Co-Primary Investigator:** Robert S. Keyser, PhD
  - Course: IET 4451
  - Responsibilities: project lead; coordinator, subject matter expert, course developer, and instructor of record.
- **Co-Primary Investigator:** Dr. Meng Han.
  - Responsibilities: instructional design support, subject matter expert;

All course design with the no-cost materials will be provided through D2L Brightspace for our students and a public website for our students as well the public.

#### 4. Quantitative and Qualitative Measures

The investigators plan to assess the effectiveness of our proposal based on both qualitative and quantitative measures. The qualitative measure includes designing a survey and gathering inputs from the students after they have used the no-cost learning materials. The survey will be distributed via Qualtrics (<https://survey.kennesaw.edu/eula/>) and student performance data will be collected from D2L. The quantitative measure will compare students' performance data against our preset goals. Generally, 75% is the passing rate goal for undergraduate courses. The detailed assessment plan is shown in Table 2.

Table 2. Course Assessment Measures

Source	Description
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Student performance measures	<p>This data is from the overall class performance based on the grading of student works. Metrics include:</p> <ul style="list-style-type: none"> <li>• Class average, grades distribution, the pass rate for each grading item.</li> <li>• Overall letter grades distribution, pass rate, withdraw rate, and fail rate.</li> <li>• Percentage of students meeting or exceeding course learning outcomes</li> </ul>
Specific survey on no-cost learning materials	<p>The survey will be distributed at the end of the semester to collect student feedback. It consists of a mixture of quantitative and qualitative measures including:</p> <ul style="list-style-type: none"> <li>• Student perception and attitude toward no-cost materials</li> <li>• Quantitative ratings of the no-cost materials used in this course</li> <li>• Qualitative comments and suggestions</li> </ul>

## 5. Timeline

The major milestones of the proposal are illustrated as follows:

- 5/30/2020
  - Complete baseline gathering of statistics
- 8/31/2020
  - Complete course-level materials redesign, which includes a Syllabus and Course Schedule
  - Complete project progress report for ENGR 1100 and IET 4451
  - Complete the development of no-cost materials include all reading, lecture notes, recorded video tutorials, assignments, and exam materials for ENGR 1100 and IET 4451
- 12/10/2020
  - Complete the initial course offering of ENGR 1100
  - Complete the survey data collection for the offered course
  - Complete student evaluations for the courses
- 5/15/2021
  - Complete the initial course offering of IET 4451
  - Complete the survey data collection for the offered course
  - Complete student evaluations for the courses
- 5/30/2021
  - Complete assessment data collection and analysis for the whole project.



- Deliver the final status report.
- Complete the final report.

## 6. Budget

The major development will be during Summer 2020. Funding will compensate the team member's work and activities during the summer. For each proposed course, no-cost-material development workload is estimated to be approximately 100 hours in total. The instructor of record will spend 20 hours in course assessment. The role of each PI with the corresponding compensation and other budget details are listed as follows:

- Dr. Lin Li
  - Role: ENGR 1100 course developer & instructor
  - Investigator compensation: \$5,000
- Dr. Robert S. Keyser
  - Role: IET 4451 course developer & instructor
  - Investigator compensation: \$5,000
- Dr. Meng Han
  - Role: Project coordinator & course instructional design support
  - Investigator compensation: \$1,000
- Travel & Other Expense: \$800. The \$800 is budgeted for two team members to attend the Kickoff Meeting at Middle Georgia State University in Macon, GA.
- Total Budget: \$11,800.

## 7. Sustainability Plan

The Department of Systems and Industrial Engineering at KSU implements a course coordination system for all courses. Each course is assigned to a faculty as the course coordinator who is responsible for the content of the course and teaches the course regularly. Our team will develop the no-cost-to student learning material for the proposed courses and the PI, Dr. Li will teach course ENGR 1100 and Dr. Keyser will teach the course IET4451 for the first time using the new material. As course coordinators, both Dr. Li and Dr. Keyser will also ensure that the courses are continuously taught using the developed no-cost learning material in future semesters, even the course may have a different instructor.

The Department of Systems and Industrial Engineering at KSU has a well-established continuous course improvement plan. Each course is assessed each semester after being taught, and every course is formally evaluated and updated every three years. The course coordinator is responsible for the course assessment. Thus, we are committed to continuously updating the no-cost learning material in the proposed course based on research, assessment results, and feedback from students and alumni. As shown in the support letter, our transformation efforts also have strong support from our department chair, which further ensures the sustainability of our transformation efforts.

Note: Letter of Support  
See attached.