

Master of Science in Sustainable Engineering

Graduate Manual

RIT

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Part 1: General Program Information

Part 1 of this graduate manual is primarily intended for students interested in learning more about the Masters of Science (MS) in Sustainable Engineering. An introduction to the program, admission requirements, and information on graduate assistantship as well as scholarship is provided in this section of the manual.

1. Master of Science Degree in Sustainable Engineering

Sustainable Engineering refers to the integration of social, environmental, and economic considerations into product, process, and energy system design methods. Additionally, sustainable engineering encourages the consideration of the complete product and process lifecycle during the design effort. The intent is to minimize environmental impacts across the entire lifecycle while simultaneously maximizing the benefits to social and economic stakeholders. The MS in Sustainable Engineering is multidisciplinary and managed by the Industrial and Systems Engineering (ISE) Department.

The Master of Science program in Sustainable Engineering provides an applied research degree in which students study sustainable engineering topics in depth and complete a capstone experience consisting of either a thesis, a project with paper, or a capstone project. Through careful construction of their plans of study and consultation with their advisor, students are able to develop tracks in areas such as renewable energy systems, systems modeling and analysis, product design, and engineering policy and management. Coursework is offered on campus and is available on a full-time or part-time basis.

2. Admission Requirements

***The MS Sustainable Engineering program is no longer accepting applications for admission.**

Admission to the Sustainable Engineering graduate program is determined based on the full evaluation of the application and accompanying material including undergraduate degree program, transcript, GPA, GRE scores, TOEFL scores (if required), letters of recommendation, and statement of purpose. The GRE is required for all students applying to the MS program.

Although applications may be submitted at any time, to be sure that your application will receive full consideration for admission to RIT in the fall semester of the next academic year, the following deadlines should be observed:

Application Timeline for Fall Semester:

January 15: All application materials must be received

March 31: Notification of admission decision/graduate assistantship decision

The general entrance requirements consist of a BS degree in engineering, technology, mathematics or science, and a minimum equivalent cumulative undergraduate GPA of 3.00/4.00. Minimum TOEFL scores of 580 (paper-based) or 90 (Internet-based) are required for students that do not have English as their first language. For students without an engineering degree, some bridge

coursework in the basic engineering sciences may be necessary prior to full admission.

3. Graduate Assistantships and Scholarships

Application for Graduate Assistantships and Scholarships can be made by checking the appropriate box on the RIT Graduate School Application indicating interest in an assistantship. Applications received before January 15, will be given priority for assistantships to be awarded for the following academic year. ***Only full-time MS students will be considered for assistantships.*** Departmental graduate assistantships may be awarded to new students for the current academic year on a competitive basis that depends on the current graduate student population, the number of applicants, and the strength of the graduate student application. Graduate assistantships awarded to new students are only guaranteed for the designated enrollment date. **If a student elects to defer admission, the student must reapply for a graduate assistantship.** Graduate assistantships for continuing students will be evaluated on a semester basis. These assistantships will be awarded on a competitive basis based on progress toward the degree including courses taken, GPA, progress toward thesis, endorsement of advisor, and performance of current assistantship duties. Departmental support for graduate students is limited to two years from the start of enrollment.

Part 2: Information for Students in the MS Sustainable Engineering Program

Part 2 of this manual includes important information for students that have entered the MS Sustainable Engineering program. This includes student expectations, graduation requirements, capstone options, and co-op information. Following this section are two important appendices.

1. Advisor

The Sustainable Engineering Graduate Program Director initially serves as the advisor for all students enrolled in the MS Sustainable Engineering program. Students that plan to pursue a thesis will obtain a thesis advisor by following the process in Section 4.3.2. It is the responsibility of the student to meet with the advisor on a regular basis to ensure the requirements of the degree are being met.

2. Graduation Requirements

The MS degree will be awarded upon successful completion of a minimum of 30 credits of study under one of the three following options:

- **Capstone Project Option:** Nine (9) graduate courses (27 credits), and complete the Capstone Project course (3 credits); or
- **Project with Paper Option:** Nine (9) graduate courses (27 credits), and complete the Project with Paper course (3 credits); or
- **Thesis Option:** Eight (8) graduate courses (24 credits), six (6) credit hours of Thesis Research, and conduct research and successfully complete a thesis.

The coursework must meet the following requirements:

- **The following required courses:**
 - ISEE-771 Engineering of Systems I
 - ISEE-785 Fundamentals of Sustainable Engineering
 - ISEE-786 Lifecycle Assessment
 - MECE-629 Renewable Energy Systems
- **1 Social Context elective**
- **1 Technology elective**
- **Engineering electives –3 courses for the Project with Paper and Capstone Project Options / 2 courses for the Thesis Option**
- **Two semesters of ISE Graduate Seminar ISEE-795 (0 credits)**

A list of approved graduate courses for meeting these degree requirements appears in Appendix A. Other graduate courses may be considered to count as an elective. To receive approval for a course substitution, please complete the Plan of Study form found in Appendix C and submit to

your advisor. Students should not assume that a graduate course approved for one student will be approved for all students.

2.1 Institute Policy – 7 Year Limit

In accordance with Institute policy, all graduate programs must be completed within seven years after taking the first graduate course(s) that applies to the program. Exceptions to the seven year rule require a petition to the Dean of Graduate Studies with an explanation as to why the student will be unable to complete the program within seven years. This request must be accompanied by a letter of from the Director of Sustainable Engineering Graduate Programs. The request must be made prior the reaching the seven year limit. Approval is not automatic.

3. Graduate Seminars

To aid students in the development of research ideas, students will complete two semesters of Graduate Seminar (ISEE-795). The seminars introduce students to research methods in industrial and systems engineering and sustainable engineering, while presenting state of the art research in those disciplines.

The seminars are designed to promote discussion and interaction on ISE and sustainable engineering research topics and to present research methods such as conducting critical reviews of research literature, initiating background research on a thesis topic, and preparing a formal thesis proposal. The seminar will include invited speakers from within and outside of RIT to present their research work and to promote discussion, cultivate ideas, and promote research. The dates for the seminar speakers will be announced and attendance by all MS Sustainable Engineering students is required.

4. Capstone Experience Options

This section describes the three capstone experience options available under the MS Sustainable Engineering degree program – (a) Capstone Project; (b) Project with Paper; and (c) Thesis.

4.1 Capstone Project

The Capstone Project Option for the MS in Sustainable Engineering requires the successful completion of the following three-credit capstone course:

ISEE-792 Engineering Capstone - Catalog Description: Students must investigate a discipline-related topic in a field related to sustainable engineering. The general intent of the engineering capstone is to demonstrate the students' knowledge of the integrative aspects of a particular area. The capstone should draw upon skills and knowledge acquired in the program.

4.2 Project with Paper

The Project with Paper Option for the MS in Sustainable Engineering provides students with the opportunity to conduct a research project as the capstone experience for their degree program. The deliverables include a conference paper and oral presentation.

4.2.1 Project Proposal

Prior to the semester that the student plans to register for the Project with Paper course (ISEE-788), the student should work with an ISE Faculty member to identify an applied research project. The project could also be co-advised by more than one faculty member, but one of the co-advisors must be an ISE Faculty member. The student must complete the Project with Paper proposal form (see Appendix B). Please note, this must be submitted on the electronic pdf form, which can be found on the ISE website under Student Resources. The ISE Faculty advisor and graduate director must approve the project. Upon approval, the student must register for the Project with Paper course.

The scope of the project should be designed to be able to be completed within one semester. The project should integrate the concepts covered in the courses taken as part of the plan of study. In addition, the student should identify a conference at which the final paper could be presented (presenting at the conference is encouraged, but not required for degree certification as the conference will likely take place after semester is finished.)

4.2.2 Project Paper and Presentation

The project paper should follow the format of the potential conference identified in the proposal. A typical project paper will be approximately 8 pages. The final paper should be submitted to the ISE Faculty advisor prior to the end to the semester. The student will give a 12-15 minute presentation of their project during the ISE Graduate Seminar, typically on the last day the class meets for the semester. A rubric has been created for evaluation of the project paper and presentation to determine the final grade for the course. The Project with Paper Rubric can be seen in Appendix B.

4.3 Thesis

There are three components of the thesis that will be described in this section: thesis advising information, the thesis proposal, and the thesis. Completing each of these items is a requirement for completion of the Thesis Option of the MS Sustainable Engineering degree.

4.3.1 Thesis Advisor and Committee

The Sustainable Engineering Graduate Program Director initially serves as a student's advisor. **Prior to committing to the thesis option, the student must obtain a thesis advisor. Identifying a thesis advisor should be completed as early as possible, and no later than the end of the student's second semester.** The formation of the thesis committee is critical to the timely completion of the MS degree. Prior to the thesis proposal defense, the student must form a thesis

committee as follows:

Step 1. The student should initiate the formation of their committee by selecting a primary thesis advisor from among the ISE Faculty (Professor, Associate Professor, or Assistant Professor) based upon the student's interests and the agreement of the new advisor. In the event that the thesis topic is interdisciplinary, the student may select a second primary advisor from among RIT faculty within or outside of the ISE Department. These two individuals would then serve as co-advisors to the student, with approval from the Sustainable Engineering Graduate Program Director.

Step 2. The student should then, in conjunction with their advisor, form a thesis committee. The committee should be comprised of at least two RIT faculty members (Professors, Associate Professors, or Assistant Professors) including the advisor. The remainder of the committee may consist of RIT faculty (including instructors or lecturers) or industrial personnel from outside RIT.

Note: In the unlikely event that the need arises for a student to change the composition of their committee; the student should submit written justification signed by all previous committee members to the ISE Department and previous committee members. The student should follow Steps 1 and 2 to re-form their committee.

4.3.2 Plan of Study for MS Thesis Option

All MS Sustainable Engineering students completing a thesis are required to complete a plan of study and submit it to the ISE office to be placed in the student's file. The student's plan of study must be mapped out with and approved by the student's thesis advisor using the appropriate Plan of Study form found in Appendix C. An electronic copy of this form can be found on the ISE website under Student Resources. Any updates to the plan of study in future terms required a new Plan of Study form to be completed, approved, and submitted to the ISE office.

4.3.3 Thesis Proposal

A thesis proposal is a document that each MS Sustainable Engineering student will develop to propose to their thesis committee. The proposal describes the research problem that they plan to investigate, the problem scope, a critical literature review, and a planned methodology. The purpose of the thesis proposal is to ensure that the student has defined a sufficient problem for the MS degree; the scope of the problem can be completed in a reasonable amount of time (typically 9-12 months); the student has a sufficient understanding of previous work to date; and that the methodology proposed can be implemented by the student with the resources available to RIT.

The student will hold an oral defense of their thesis proposal to their thesis committee. The thesis proposal defense date will be mutually agreed upon by the student and the committee members. The student should submit the thesis proposal document to the thesis committee at least 2 weeks prior to thesis proposal defense. The committee members will each complete a thesis proposal rubric and will come to a mutual agreement on the overall thesis proposal outcome.

The student should submit the approved thesis proposal signed by all committee members to the ISE office. This should be completed at least 6 months prior to the student's expected thesis defense date. Once a thesis proposal has been successfully defended and accepted by the committee, requests to change the scope of work will generally not be granted. In the event a change in scope is required, the student must submit a formal document detailing the changes to all committee members. Once all committee members have approved and signed the document, the student should submit the document to the ISE office.

4.3.4 Thesis Document and Defense

The thesis student should obtain approval from their thesis advisor when both the student and the advisor mutually agree the student has completed all of the work outlined in the thesis proposal. A thesis is a document that describes the thesis research problem, the problem scope, a thorough and critical literature review, a methodology, results of the methodology, conclusions, and suggestions for future research. Students are strongly encouraged to prepare the thesis in a format suitable for publication in a refereed journal prior to thesis defense.

The student should submit a complete copy of their thesis to the committee at least four weeks prior to the thesis defense. The student should schedule a mutually agreeable time to hold an oral defense of the thesis with all committee members. The oral defense of the thesis is conducted in front of the thesis committee and will be open to the Institute.

Students are encouraged to work with their advisor, the Sustainable Engineering Graduate Program Director, and the ISE office staff to find a suitable room and time to defend the thesis. The student must submit the following information to the Sustainable Engineering Graduate Program Director two weeks prior to the oral thesis defense date: title of the thesis, thesis abstract, thesis committee members, thesis room, date, and time. This information will be announced and publicized prior to the defense date.

At the oral defense of the thesis, the student's thesis committee will judge the thesis using the following options: pass, conditional pass, adjournment, or failure. Pass means the thesis has been successfully defended and the document is accepted in its current format. Conditional pass means that the thesis defense was successful, however, some revisions to the work presented in the thesis document must be made prior to the thesis committee accepting the document. Adjournment means that the thesis defense and document were not adequate to warrant a pass, but the student may make the changes required by the thesis committee and re-defend the thesis. The adjournment options require revisions to the thesis document as well as another oral defense and the student must proceed with the above outlined procedures for scheduling the defense. Failure means that the thesis committee has rejected the thesis. The committee decided upon a failure if they feel the student has not adequately defended the thesis, the thesis research is not sufficient, and/or the thesis document is not satisfactory. If the committee rejects the thesis, the student should explore non-thesis degree options (e.g., Master of Engineering degree).

Once the thesis has been successfully defended and all revisions have been completed, and approved by the committee, an electronic copy of the thesis must be submitted to the library via ProQuest. **For additional information on thesis binding and electronic submission of the**

thesis please see: <http://infoguides.rit.edu/thesis-services>. The e-mail verification of electronic submission must be provided to the ISE department as proof of completion and eligibility of certification.

4.3.5 Thesis Credits and Degree Requirements

The thesis option requires 6 thesis credits. Please note these thesis credits cannot be used in substitution for other course requirements (except in rare circumstances with permission from the Sustainable Engineering Graduate Program Director). This means that if you take 3 or 6 thesis credits, but then decide to switch to another capstone option, like Project With Paper, these 3 thesis credits will not be able to be applied to your degree requirements. This will result in you needing to take 33 - 36 credit hours to complete your degree and could have financial impacts.

5. Student Expectations for Graduate Assistantships and Scholarships

The ISE Department is fortunate to be able to provide a number of graduate scholarships and assistantships to Master of Science students, and tries to be as generous as possible in funding graduate students to study at RIT. From the perspective of the ISE Department, this funding is an investment in graduate students and the research work that students will produce while working with the ISE faculty.

The expectation for students receiving scholarships and assistantships includes (but is not limited to) the following:

- Being present at RIT during the academic semesters including the weeks of exams and excluding official institute breaks (between semesters, winter break, etc.). The RIT academic calendar is announced well in advance of each academic year. Students must consult this when making travel reservations, etc.
- Attend and perform well in classes. Students must maintain a minimum GPA of 3.00 to remain in good academic standing.
- Make good progress towards completing the degree program within two academic years by taking classes, establishing a thesis topic, establishing a thesis advisor and committee, submitting a plan of study, submitting a thesis proposal, etc.
- Behaving in an ethical manner inside and outside of class.

The additional expectations for students receiving assistantships include (but are not limited to) the following:

- Working the scheduled time according to your assistantship (e.g. 10 hours/week). In some cases, such as teaching assistantship assignments, the work may vary from week to week, but should average out to this quantity over the semester.
- Report regularly to the faculty advisor administering the assistantship.
- Perform work to the best of your ability and meet due dates for assigned tasks.

Graduate students should be aware that not fulfilling the expectations of graduate assistantships may result in a corresponding reduction in scholarships and assistantships. Furthermore, the items outlined above will be taken into account when evaluating graduate scholarship and assistantship awards in future semesters.

6. Cooperative Education (Co-op)

Cooperative education (Co-op) is an optional part of the ISE graduate programs. Co-op is a paid work experience at a company designed to help educate students through the application of academic course material in a work environment. If a graduate student elects to pursue a co-op position, the co-op must be done as an integral part of the plan of study for the graduate degree program.

Communication with your advisor about your intent to co-op is extremely important. You should have a discussion with your advisor to determine how the co-op will be integrated into the degree program to ensure continued progress of your research and the effect on your expected graduation date (if any). Students requesting approval to co-op are required to submit a Plan of Study form to their advisor. The Plan of Study form can be found on the ISE website under Student Resources. Approved plans of study must be submitted to the ISE office to be added to the student's file.

The RIT Office of Career Service and Cooperative Education has a process that students must follow to enroll in co-op. This includes attending a Co-op Prep Session before using their services. This Co-op Prep Session is typically held a group session for ISE Department degree programs (date and time will be announced).

For international students, additional co-op rules and guidelines may apply and are available through the International Student Services Office. At the time this document was published the following requirements must be met prior to international students going on co-op:

- Minimum of 18 credit hours completed
- Minimum of 2 academic semesters on campus (Fall and Spring)

For students wishing to co-op, a co-op will only be approved if the student has a minimum GPA of 3.0.

Appendix A: Potential Graduate Courses

The list of potential courses below represents courses that will earn credit as valid graduate courses. The Sustainable Engineering Graduate Program Director will consider other courses on a case-by-case basis and courses will only be accepted if the student has discussed the choice with his/her advisor and received permission from the advisor in writing. To receive approval for a course substitution, please complete the Plan of Study form and submit to your advisor. Approved plans of study must be submitted to the ISE office to be added to the student's file. Students should not assume that a graduate course approved for one will be approved for all students.

Engineering Electives

- ISEE-601 Systems Modeling and Optimization
- ISEE-626 Contemporary Production Systems
- ISEE-640 Computer-Aided Design & Manufacturing
- ISEE-660 Applied Statistical Quality Control
- ISEE-661 Linear Regression Analysis
- ISEE-682 Lean Six Sigma Fundamentals
- ISEE-684 Engineering and the Developing World
- ISEE-701 Linear Programming
- ISEE-702 Integer and Nonlinear Programming
- ISEE-703 Supply Chain Management
- ISEE-704 Logistics Management
- ISEE-708 Simulation Analysis
- ISEE-711 Advanced Simulation
- ISEE-720 Production Control
- ISEE-723 Global Facilities Planning
- ISEE-728 Production Systems Management
- ISEE-730 Biomechanics of Human Movement
- ISEE-731 Advanced Topics in Human Factors & Ergo.
- ISEE-732 Systems Safety Engineering
- ISEE-734 Graduate Engineering Psychology
- ISEE-740 Design for Manufacture and Assembly
- ISEE-741 3D Printing
- ISEE-742 Metal & Composite Additive Manufacturing
- ISEE-743 Personalized 3D Printing
- ISEE-745 Manufacturing Systems
- ISEE-750 Systems and Project Management
- ISEE-752 Decision Analysis
- ISEE-760 Design of Experiments
- ISEE-761 Forecasting Methods
- ISEE-770 Design Project Leadership
- ISEE-772 Engineering of Systems II
- ISEE-787 Design for Environment
- ISEE-789 Special Topics
- ISEE-799 Independent Study
- MCEE-620 Photovoltaic Science & Engineering
- MECE-606 Systems Modeling
- MECE-650 Sustainable Energy Use in Transportation
- MECE-731 Computational Fluid Dynamics
- MECE-733 Sustainable Energy Management
- MECE-738 Ideal Flows
- MECE-739 Alternative Fuels and Energy Efficiency
- MECE-744 Nonlinear Control Systems
- MECE-751 Convective Phenomena
- MECE-754 Fund. of Fatigue and Fracture Mechanics

Social Context Electives

- ECON-620 Environmental Economics
- ENV5-631 Climate Change: Science, Technology & Policy
- INTB-730 Cross-Cultural Management
- ISUS-706 Economics of Sustainable Systems
- MGMT-710 Managing for Environmental Sustainability
- PUBL-610 Technological Innovation & Public Policy
- PUBL-630 Energy Policy
- PUBL-631 Climate Change: Science, Technology & Policy
- PUBL-789 Special Topics (requires prior approval)
- PUBL-810 Technology, Policy, & Sustainability
- STS0-750 Graduate Sustainable Communities

Technology Electives

- ESHS-613 Solid & Hazardous Waste Management
- ESHS-614 Industrial Wastewater Management
- ESHS-615 Air Emissions Management
- ESHS-665 Sustainable Product Stewardship
- ESHS-720 Environmental Health & Safety Management
- ESHS-725 EHS Accounting & Finance
- ESHS-755 Corporate Social Responsibility
- PACK-730 Packaging and the Environment

Appendix B: Project with Paper Proposal and Rubric

ISEE-788 - Project with Paper approval

Student's Name _____ UID# _____

Date _____ Term _____ Faculty Sponsor _____

Title of Proposal _____

Please see the instructions on the following page regarding what to include in each section of the form.

Proposed Project Description

Integration of Courses

Targeted Conference

ISE Seminar Presentation

Project Plan

Evaluation of Project with Paper – The project with paper will be evaluated based on the resulting paper and presentation using the ISE Project with Paper rubric. Please refer to the rubric as you are conducting project and developing the paper and presentation.

Student Signature _____ Date _____

Faculty Sponsor Signature _____ Date _____

Graduate Program Director Signature _____ Date _____

NOTE: This form must be completed prior to enrolling in Project with Paper (ISEE-788).

INSTRUCTIONS

Please include the following information in the corresponding section of the form.

Proposed Project Description

Describe the following:

- Project/research problem (hypothesis/research question)
- Methods that will be used to complete the project
- Experimentation
- Analysis Methods
- Expected outcome and contribution

If the project will involve human subjects, you must obtain IRB approval BEFORE registering for the Project with Paper course.

Integration of Courses

- Briefly describe how the concepts/material covered in the courses on the plan of study will be integrated in the proposed project.

Targeted Conference

- Name, date, and location of potential conference
- Is the targeted conference paper template available? If not, which conference template will you plan to use?

ISE Seminar Presentation

- Planned presentation date (please schedule with ISE Graduate Director)

Project Plan

- Include Gantt chart and description of tasks to be completed
- Include in this, your plan to meet with your faculty sponsor regularly throughout the project.

Project With Paper Grading Rubric

Student Name: _____

Paper Title: _____

Presentation Date: _____

Faculty Advisor: _____

The student's paper and 15 minute oral presentation are used to assess the student's ability to:

- evaluate current research work in the application domain and identify how their work adds to previous work
- use good judgment and creativity to determine an appropriate methodology
- present and discuss their research findings
- identify appropriate conclusions and areas of future work.

Advisor Instructions: Please fill out and sign this form after you have assessed your student's presentation and paper. Return this form to the graduate director, so they can enter in the grade in SIS. This rubric will be shared with the students, so please leave appropriate feedback in each section of the rubric.

Performance Assessment	Component Raw Score			Percentage
	out of 20	out of 15	out of 10	
Excellent	18.0 - 20.0	13.5 - 15.0	9.0 - 10.0	> 90%
Good	16.0 - 17.5	12.0 - 13.0	8.0 - 8.5	> 80%
Fair	14.0 - 15.5	10.5 - 11.5	7.0 - 7.5	>70%
Unsatisfactory	< 14.0	< 10.5	< 7.0	< 70%

Project Component – Please leave written feedback for students.	Score	Maximum Score
Quality of the Writing		15
Program Outcome: Communication <i>Communicate effectively through <u>written</u>, oral, and graphical means</i>		
A High Quality Written Paper Will <ul style="list-style-type: none"> • Be “submission ready” with regards to grammar and spelling • Will offer a smooth flow of ideas, and general readability • Contain appropriate headings and subheadings • Contain Properly Cited Resources (5 pts) 		
Quality of the Presentation		15
Program Outcome: Communication <i>Communicate effectively through <u>written</u>, <u>oral</u>, and graphical means</i>		
A High Quality Presentation Will <ul style="list-style-type: none"> • Be well organized • Communicated clearly (clearly annunciated, delivered at a good pace) • Stay within allotted time limit (15 minutes) • Be well put together without too many details on a single slide • Will avoid large walls of text • Student will speak to slides, but WILL NOT read from slides • Have figures large enough to see, and be explained thoroughly • Answered questions thoughtfully and concisely 		
Engineering Graphics		10
Program Outcome: Communication <i>Communicate effectively through <u>written</u>, oral, and <u>graphical</u> means</i>		
All Graphics in the <u>Presentation and Paper</u> Will: <ul style="list-style-type: none"> • Have informative titles (presentation) and captions (paper) • Graphs will have <ul style="list-style-type: none"> ○ Clearly labeled X and Y Axis ○ A scale that is appropriate for the data shown ○ X and Y axis tick labels that are readable and in proper formats ○ A legend if needed ○ A color/pattern scheme that makes differentiating data easy 		

<ul style="list-style-type: none"> Graph formats chosen are appropriate for the data being displayed 		
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Engineering Methods - Methodology		20
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<p>Outcome: Engineering Methods <i>Apply math, science, and engineering principles to identify, formulate, conduct experiments, analyze, and solve industrial and systems engineering problems using appropriate techniques, skills, and modern engineering tools necessary for engineering practice</i></p> <p>An Excellent level project will:</p> <ul style="list-style-type: none"> Methodology <ul style="list-style-type: none"> Provide clear description of how data was collected Provide clear description and proper justification of analysis tools, equations, and measures of performance used Discuss any assumptions made or methodology limitations Enough clarity and detail that the work could be reproducible. 		
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Engineering Methods – Data Analysis and Conclusions		20
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<p>Outcome: Engineering Methods <i>Apply math, science, and engineering principles to identify, formulate, conduct experiments, analyze, and solve industrial and systems engineering problems using appropriate techniques, skills, and modern engineering tools necessary for engineering practice</i></p> <p>An Excellent level project will:</p> <ul style="list-style-type: none"> Results and Discussion <ul style="list-style-type: none"> Have results that are presented in an appropriate manner (tables and figures) that supports methodology previously described Have statistical analysis, that if used, are appropriate and accurately interpreted Have clearly explained results and interpretations of results. Importance and relevance of results is discussed Conclusions <ul style="list-style-type: none"> Conclusions provided can be drawn from research performed in paper Conclusions demonstrate new insights provided to the literature or to industry partner from the study performed Suggestions for future research are thoughtful and insightful 		
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1. OVERALL SCORE		80
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A score of 58 or better is required for degree completion.

Advisor Signature: _____ Date: _____

Graduate Director Signature: _____ Date: _____

Course Grading: A: 74 – 80 pts, A-: 72-73 pts

B+: 69 – 71 pts, B: 66-68 pts, B-: 64- 65 pts

C+: 61 – 63pts, C: 58 – 60pts, C-: 56-57 pts

D: 48- 55pts, F: 0-47 pts

For overall score, round to whole number, e.g. 187.5 -> 188.

Significant content taken from: <https://www.cornellcollege.edu/LIBRARY/faculty/focusing-on-assignments/tools-for-assessment/original-research-project-rubric.shtml>

Appendix C: Plan of Study forms

Master of Science in Sustainable Engineering – Capstone or Project with Paper Options
 SUSTAIN-MS
 Plan of Study

Name: _____
 E-mail: _____

RIT ID: _____

<i>Course</i>	<i>Semester</i>	<i>Grade</i>	<i>Credits</i>
1. ISEE-771 Engineering of Systems I			3
2. ISEE-785 Fundamentals of Sustainable Engineering			3
3. ISEE-786 Lifecycle Assessment			3
4. MECE-629 Renewable Energy Systems			3
5. Social Context elective			3
6. Technology elective			3
7. Engineering elective			3
8. Engineering elective			3
9. Engineering elective			3
10. ISEE-792 Engineering Capstone or ISEE-788 Project w/Paper			3
ISEE-795 Graduate Seminar			0
ISEE-795 Graduate Seminar			0
Total			30

Advisor: _____

Signature: _____

Date: _____

Ending GPA: _____

Master of Science in Sustainable Engineering (SUSTAIN-MS) – Thesis Option
 Plan of Study

Name: _____
 E-mail: _____

RIT ID: _____

<i>Course</i>	<i>Semester</i>	<i>Grade</i>	<i>Credits</i>
1. ISEE-771 Engineering of Systems I			3
2. ISEE-785 Fundamentals of Sustainable Engineering			3
3. ISEE-786 Lifecycle Assessment			3
4. MECE-629 Renewable Energy Systems			3
5. Social Context elective			3
6. Technology elective			3
7. Engineering elective			3
8. Engineering elective			3
*9.			
ISEE-790 Research and Thesis			6
ISEE-795 Graduate Seminar			0
ISEE-795 Graduate Seminar			0
Total			30

Thesis Title: _____

Proposal Submission Date: _____

Thesis Advisor: _____ Signature: _____ Date: _____

Committee Member (s): _____

Defense Date: _____

Completion Date: _____

* Course not required to fulfill degree requirements

Ending GPA: _____

Appendix D: MS Sustainable Engineering Program Checklist (Thesis Option)

Industrial & Systems Engineering Department, RIT

Name _____

Enrollment Date _____

Task	Target Date	Date Completed
1. Establish an advisor for your thesis	First semester	
2. Submit plan of study signed by thesis advisor	First semester	
3. Establish a thesis topic	Second semester	
4. Form a thesis committee	Second semester	
5. Complete thesis proposal	End of second semester (submit to committee at least two weeks prior to proposal presentation)	
6. Thesis proposal defense	End of second semester	
7. Submit approved and signed thesis proposal to ISE Department	End of second semester	
8. Complete thesis document	End of fourth semester (submit to committee at least 10 business days prior to presentation)	
9. Schedule thesis defense (give thesis title, abstract, committee members, location, and date/time information to Graduate Program Director)	At least two weeks prior to presentation date	
10. Thesis presentation	Fourth semester	
11. Make revisions to thesis (if required)	Fourth semester	
12. Obtain all committee members' signatures	End of fourth semester	
13. Submit electronic copy of thesis to RIT Library through ProQuest.	End of fourth semester	
14. E-mail verification of electronic submission to ISE Department	End of fourth semester	