AME 441aL & 441bL Senior Projects Laboratory
Spring 2020

Laboratory: **M,W 10:00 – 12:50**
BHE 301

Lecture: **T 11:00 - 12:20**
BHE 310

Professors: Dr. Matthew Gilpin
PHE 314
gilpin@usc.edu

Office Hours: See Blackboard/Piazza for Faculty and Staff Lab Times

Laboratory Technicians:	Jeffrey Vargas	Rodney Yates	William Colvin
BHE 310, (213) 740-4304	vargasje@usc.edu	rodneyya@usc.edu	wcolvin@usc.edu

Recommended Texts (not required):

Beckwith, T.G. & R.D. Marangoni. *Mechanical Measurements*, 6th ed., Addison Wesley.

Holman, J.P. *Experimental Methods for Engineers*, 7th ed., McGraw Hill.

Figliola & Beasley, *Theory and Design for Mechanical Measurements,* Wiley.

Important note to all students registered for AME 441aL & AME 441bL:

During the Spring semester, the senior projects course will consist of students enrolled in both 441a and returning students from the fall who are enrolled in 441b. For most of the class, including lectures, meeting times, and the deliverables schedule, everything will be identical. However, there are some key differences that I will highlight here.

AME 441a: New Projects

Welcome! You are about to spend the semester investigating something that interests *you*. In contrast to the Fall semester, groups will be smaller. Pair up into a **group of two** and start thinking about what you want to investigate before the semester begins.

Being in a smaller group is not a greater burden – in fact, it allows you to be more targeted in your project scope. Think about a project that ideally suits your interests and attack it head on. With the resources available, you can achieve more that you think! This is chance to tangibly explore something fascinating and demonstrate to future employers your engineering capabilities.

AME 441b: Returning Projects

Welcome! In 441a, you and your group have already solved the easy problems – now, you *must* tackle the hard ones. Your group will be working together, as you were last semester, and it is expected that the quality of deliverables will reflect the size of your team.

AME 441b requires you to interpret the results of your previous semester, apply the knowledge learned, and go beyond simply enhancing your data from the Fall. It is expected that you use your previous experience to produce publication quality results this semester.

Senior Projects in Aerospace and Mechanical Engineering
Spring 2020

*v1, all dates are subject to change *

I. Introduction

The aim of this course is to complete an original project of your own creation which will take you through the entire engineering process. The semester starts with planning and design, and ends with experimental validation. This course gives students the responsibilities associated with an industrial research project while keeping them within a teaching environment. Students will experience similar problems and challenges that will be faced upon graduation and develop a more thorough understanding of the steps involved to complete an actual engineering project. An emphasis on novel experimental work means that one's ingenuity and initiative are a major factor in success.

Students work in groups of **two** (for 441a) on a project of their choice for the entire semester. Topics for these projects are ideally provided by the students themselves. However, projects can be selected from a number of ideas suggested by the faculty. **Think about where you want to be next year and make this project the centerpiece of your academic and budding professional portfolio.** A well-executed senior project is an excellent interview topic!

The extent of the subjects covered is quite broad. Project topics have ranged from traditional areas such as fluid dynamics, structural mechanics, heat transfer, and dynamic control, to less-traditional studies on fishing line motion, plant growth in varying pressure environments, structural fire behavior, etc. The primary requirement in the selection of a topic is that the student must have a strong personal interest. More pragmatically, design, construction and testing should be possible within one semester given the constraints of the lab facilities and a set financial budget.

We also encourage students to contact any of the faculty listed in Appendix G and Appendix H at the end of this handout directly for ideas in their respective fields of interest and expertise.

The AME 441 schedule compresses an entire design project into a 17 week period. So, we need to hit the ground running! You will have an assignment due the **first day of lecture** **(11am Tuesday, January 14th).** Prior to beginning the semester, you need to form your team, select your project, and conduct a **literature review**. The requirements for this can be found in Appendix A. This will enable us to begin the semester with educated discussions on your topic.

The next deliverable is the **project proposal**. Before work can begin on any project, acceptance of this formal, written proposal is required. The proposal is due **Friday, January 31st before 12pm**. The proposal will be promptly returned with feedback so work may begin. If a project is not approved, required changes must be made promptly before re-submitting the proposal. Work on the project *cannot* begin until project approval has been given.

Friday, February 28th, the first written progress report is due at 12pm. There will be three total written progress reports during the semester (Feb 28, Mar 27, Apr 17)**.** These will be graded on technical content and progress made, as well as quality, clarity, and professionalism. See Appendix C for format requirements as well as the progress milestones required. Each group will also give one formal **oral presentation** on their work to the rest of the class; presentations will take place during the lecture section after Spring Break.

*v1, all dates are subject to change *

Each student group will be required to present their project at the KIEUL Senior Design Expo. This **poster session** will be in late April (date TBD) and is a great opportunity to show everyone else the amazing things you've accomplished in AME 441! Details are given in Appendix E.

Finally, one **Final Report** of publishable quality will be required by each *group* at the end of the semester; this report is due **Friday, May 8th before 5pm**. Students will be evaluated on the quality and content of their reports and presentations as well as their performance in the laboratory; this includes cleanliness of work areas, adherence to lab safety protocol, and attendance/participation in the scheduled lecture and laboratory sessions.

Document Submission

TurnItIn will be used for submitting most of your group assignments. This includes the Literature Review, Proposal, Progress Reports, and Final Report. Look in \\Blackboard\Assignments\ for document submission links. When **Peer Evaluations** are due, a paper submission is required. These will be submitted (anonymously) to the RRB Lobby, where a drop box is located.

INCLUDE YOUR GROUP #, DATE, TITLE AND NAMES OF THE AUTHORS ON ALL ASSIGNMENTS

File naming convention: name all files submitted through TurnItIn starting with your two-digit group number (G##). For example:

- G42_literature_review.pdf
- G42_progress_report_1.pdf
- G42_progress_report_2.pdf
- G42_progress_report_3.pdf
- G42_final_report.pdf

II. AME Lab Procedures and Protocol

Safety and Space Management

- ***CLOSED-TOE SHOES*** **AND** ***LONG PANTS*** **ARE REQUIRED IN THE LAB AT ALL TIMES.** ***NO EXCEPTIONS!*** Shoes need to provide protection; hence, "Toms", boat shoes, flats, slippers, etc. don't qualify. Pants need to be pants.
- Safety precautions (gloves, eye protection, hair ties, etc.) are mandatory. Ask a staff member if you are unsure of any safety precautions you should be taking when working in the lab.
- According to University rules, students are not allowed in the lab without supervision. Therefore, all experiments must be performed within the scheduled lab times.
- Store your personal belongings out of walking paths – under work tables for instance. It is important to keep a clear and safe walkway through the laboratory.
- Keep the lab clean. ***No food or drinks*** in the lab areas. You are welcome to have food or drinks in the hallway, near the stairs, or in the BHE 301 presentation room (outside of AME 341 lab hours).
- **Return all lab equipment to its original location** after use (cables, beakers, drill bits, etc.).
- There is a small engineering library in BHE 301. These resources are to be shared and ***are not to leave BHE.***

Supply Room and Device Access

- Access to the BHE 301 Supply Room is restricted to staff. Most tools and equipment are provided for student access in BHE 310.
- Any/all resources and devices that leave the Supply Room ***must*** be approved, checked out, and signed for by an AME 441 staff member.
- Please promptly report any/all broken or non-functioning equipment and devices to the staff. This is *extremely* important, and will save everyone time and trouble in the future!
- When requesting equipment, students must be prepared to give all the pertinent characteristics they require so that the staff can act on the requisition effectively.
- On some occasions, it becomes necessary to share equipment with other groups. Under these circumstances all parties involved are expected to be considerate and cooperative.
- **When requesting to have parts fabricated/machined, ensure that your designs are complete** – design by trial and error will not be permitted. Be prepared to thoroughly present and explain your design in order to facilitate the approval and scheduling of part fabrication/machining. See manufacturing notes in Section IV.

Computer/Printing Rules

- Do ***not*** customize any computer workstations. This includes modifying the desktop, any/all computer settings, or installing any software without staff approval.
- Save files **only** in the following directory: **D:\home\JStude**. *Other locations will be deleted!*
- Remember to save your work to the computer's hard drive before moving it to a USB key or portable storage device. This serves as a backup.
- Printers are available only for printing of assignments, reports, and required materials for AME 441 **only**.

III. Facilities

The AME Lab in BHE has served *decades* of AME 441 classes and is well stocked with the *majority* of the tools needed to support a successful project. The lab will provide PC's, data acquisition devices and software for design, data capture and analysis. Common instrumentation is also available including digital image and video recorders, high-speed cameras, various pressure transducers, low power lasers, thermocouples, etc. If the required instrumentation is not readily available in the lab, it can often be procured from other departments on a loan basis (*e.g.*, a micropipette could be borrowed from the chemistry department).

In addition to basic scientific equipment, the BHE labs have larger test facilities. The AME Lab has a low-turbulence, open-circuit wind tunnel located in BHE 301. The test section measures 46 x 46 x 91 cm, and can provide freestream velocities from 3 m/s to 46 m/s with less than 1% variation from the mean. It is equipped with two, six-component force balances: one is capable of measuring lift and drag forces of up to 67 N and 35 N, respectively, and the other to 12 N. A low-speed water channel, built as a previous AME 441 project, is also available and located in room BHE 110. The test section of this water channel measures 0.18 m x 0.20 m x 0.91 m, and has a test velocity range of 0.05 to 0.15 m/s. Flow visualization can be performed through the transparent, acrylic test section walls. Data acquisition for these facilities is possible through a multifunction DAQ device and LabVIEW.

For well-planned projects, advanced AME department facilities can also be made available for AME 441. One such facility is the large water channel in RRB 107. The test section of this water channel has a cross-section of 0.91 m x 0.14 m, and has a usable length of approximately 3.5 m. Test velocities range from 0.12 m/s to 0.40 m/s. Flow visualization is possible through the transparent side walls and drag force measurements can be performed using the existing force balance setup. An advanced Particle Image Velocimetry (PIV) system, capable of measuring 2-D velocity fields, may also be made available for well-designed projects which require this capability. Due to the limited availability, operational complexity and safety requirements of the PIV system, students who intend to use this system are required to discuss their project with AME 441 instructors and Dr. Luhar before including its use in their project proposal.

IV. Manufacturing

Every AME 441 project will require some fabrication and the AME lab has multiple facilities allowing you to create custom fabricated components for your project. Note, that this is a design course, so all parts must be justified with quantitative reasoning about key design decisions.

The AME lab has a pair of laser cutters. Each cutter has a 60cm x 30cm bed and is capable of cutting 2D shapes from balsa wood, thin plywood and acrylic. When designing parts for AME 441, the laser cutters should be your ***FIRST*** thought. Unlike other manufacturing facilities, the laser cutters are capable of producing *same day* parts for your project. Think about how you can build up multiple 2D shapes into 3D structures. Also think about your structural requirements and if cast acrylic can be a viable material.

The AME lab also has multiple MakerBot 3D printers. While additive manufacturing is an exciting topic in all disciplines of engineering, it is asked that students restrict 3D print jobs to parts and designs that actually ***need*** to be 3D printed. The 3D printers have a long lead time and successful prints typically require multiple iterations. 3D printers are *not* a tool for lazy design. Typically, the majority of jobs submitted for additive manufacture can be produced faster and with higher quality using conventional techniques.

Finally, the AME lab has a full machine shop enabling in-house manufacturing. Rod Yates has decades of machining experience; if you can think of it, it can likely be made. Students *must* be involved in the manufacturing of their components and training is available to enable students to craft their own parts. The AME 441 shop is not a place where you submit drawings and walk away. It is a place for you to learn how things are manufactured by being actively involved in the process. Missed manufacturing appointments will result in parts being bumped from the machining schedule and these delays will cause your project to suffer.

ALL machine shop jobs must be scheduled through Rod Yates and will be completed on a first-come first-served basis. The scheduling deadline for the AME 441 machine shop corresponds with the due date of the first progress report on **February 28th**. Parts submitted and approved by this deadline will set the manufacturing schedule and will have completion priority. It is *strongly* encouraged that parts be submitted before this deadline.

For all of the above facilities, manufacturing will not be scheduled until the part has been approved by both "Engineering" (Dr. Gilpin) and "Manufacturing" (Jeffrey Vargas: Laser Cutter & 3D printer, Rod Yates: Machine Shop). Drawings must be submitted on paper, *in-person* and be initialed by both "Engineering" and "Manufacturing" staff for complete approval.

Drawings must be professional quality, computer generated and have at a minimum:

- 3-View
- Dimensions
- Necessary tolerances
- Part material
- Signature block for approvals

Additional manufacturing facilities are available including the Fab Lab in RRB 114 and the USC machine shop in KAP B-1B (M-F, 6:30 AM – 2:30 PM). If these facilities are used, it is the responsibility of the student to submit and schedule parts.

V. Budget

Each *student* is allotted approximately $100 for the purchase of expendable materials. While this appears to be a small amount, nearly all of the required components for successful projects are already available in the AME Lab. Typically, project groups will only need to charge 1 or 2 items to their project budget and the *majority* of groups do not exceed their allotment. The total amount of funding for a project will be based on the budget submitted with the proposal and may exceed the specified amount if it is deemed necessary for the project's success. Should you need to make a purchase, follow the guidelines below:

Prior to making any purchase, approval is required by your instructor. The detailed procedure for making purchases from online retailers will be discussed during the first week of class. In general, you will prepare an order, print the detailed summary but **do not** submit the order confirmation. Bring the printout to your instructor for a signature and give the order summary to the TA in charge of placing the orders.

If your project is able to utilize reusable hardware kept in a standard configuration, which can be used for later AME 441 semesters, this hardware will not be considered “consumable” and will ***not*** be charged against your group’s project budget. Examples include 80/20 channel, diagnostic equipment, tooling, etc. Care must be taken to ensure reusability at the end of the semester and instructor approval is required before orders can qualify for this exemption.

Students may make smaller purchases and be reimbursed upon presentation of an original receipt. ***Pre-approval is required from an AME 441 instructor prior to making small purchases.*** Items from the Engineering Machine Shop (KAP Basement), Electronic Store (OHE 246), and Chemistry Store (SGM 105) can only be obtained on an Internal Requisition; student purchases from these places cannot be reimbursed.

No reimbursements will be made if the above procedures are neglected. No exceptions!

VI. Grading

Grades are based on both individual and group performance. Descriptions for all deliverables and a sample grade sheet for the oral presentations are provided in Appendix A through **Error! Reference source not found.**. All assignments are expected to be of professional quality. Everyone has completed AME 341 and those standards should be followed.

Students will also be graded on their individual performance in the laboratory. To facilitate this, and provide guidance on each group's research, conferences with one or more instructors will be held at regular intervals. During these conferences, current work and problems are to be discussed and evaluated. The instructors should be notified immediately of any difficulties in the research, as delays will have an adverse effect on performance assessments. **It is essential that these projects are worked on continuously; waiting until the last few weeks will surely be detrimental to your grade.** Successful projects are the result of a sustained effort that begins on week one.

Part of the laboratory performance grade will also be adherence to safety guidelines. Each safety violation will result in a 3 point reduction in your lab performance grade. This is a serious penalty for a serious issue. There is no such thing as a “quick cut” or “quick job”; that is how you quickly loose an eye.

All students are required to attend the oral presentations during their registered lecture section. Attendance will be recorded and one absence will be permitted; use it wisely (e.g. for a job interview, etc.). A 10% penalty will be applied to your oral presentation score for each additional absence. Arriving late or leaving early counts as an absence.

Each group is required to keep a laboratory notebook as described in Section VII. This is to be turned in with the final report at the end of the semester. This year we have put added emphasis on the maintenance of this laboratory notebook – incomplete and untidy entries will result in a 5% penalty, applied to your final grade. The notes, thoughts and sketches contained in the notebook should be informative and useful. Write in this notebook as if you were planning on giving it to another 441 group next year. They should be able to easily continue your project based solely on the information contained within.

Each student must complete, or have already completed the mandatory lab safety training and workshop within the first two weeks of labs. **Lab work on your project will NOT be permitted until this training has been completed**. Failure to complete the training within the announced time frame will result in a 5% penalty on your final grade.

The grade distribution for the course is detailed in Table 1. This distribution is subject to change. Also note that overall performance in this class is cumulative. It is difficult to write a high-quality Final Report if your project doesn't begin with a high-quality proposal.

Table 1. Final Grade Weight Distribution (%)

Literature Review & Proposal	10
Progress Reports	10
Oral Presentation	15
Lab Performance	15
Final Report	40
Poster Presentation	10
TOTAL	**100**

VII. Deliverables

<u>INCLUDE YOUR GROUP #, DATE, TITLE AND NAMES OF THE AUTHORS ON ALL ASSIGNMENTS</u>

Table 2: Schedule of Deliverables

Literature Review	1st Lecture, Jan. 14th, Submit in class
Project Proposal	January 24th, 12pm
Progress Report 1	February 28th, 12pm
Progress Report 2	March 27th, 12pm
Progress Report 3	April 17th, 12pm
Oral Presentations	Post Spring Break, TBD
KIEUL Senior Design Expo	**TBD**
Laboratory Notebook	**May 8th, 5 pm**
Final Report	**May 8th, 5 pm**

- **<u>The first deliverable is the Literature Review</u>**. This is due on the **FIRST DAY OF LECTURE.** This document should be 3-4 pages in length and include your team members, your project idea and a summary of research which has led you to your topic. More details are given in Appendix A.

- **<u>The second deliverable is the Project Proposal.</u>** At a minimum, the proposal should follow the guidelines provided in Appendix B. Only one document per group is required. Proposals are due **Friday, January 24th at 12pm**. It is recommended that you discuss any ideas and/or approaches with your instructors, TA's and lab staff before and during this process. Remember, work may not begin until the project has been approved.

- **<u>Progress reports are due at 12pm, starting February 28th</u>.** Only one per group is required and the contents should follow the suggested guidelines presented in Appendix C. A total of three (3) progress reports will be handed in throughout the semester. These will be graded on the amount of project progress achieved, as well as clarity in technical communication.

With every progress report, **each** group member is required to submit a **<u>Group Evaluation Form</u>** online. Forms will be kept confidential and are intended to assess the involvement of each group member and the group dynamics of each team.

- **<u>Oral presentations will be given during the lecture session</u>** after Spring Break. The order of presentations will be determined by lottery. Presentations will be 20 minutes long, which includes time for questions. A sample grade sheet for the oral presentation can be found in Appendix F. On your presentation day, arrive at lecture 15 minutes prior to the start of class and upload your file to the class computer.

- **<u>The KIEUL Senior Design Expo is typically scheduled in late April</u>**. The poster session is a chance for you to share your work with the Viterbi community. Details for this event are given in Appendix E. Groups will be required to both create and present a poster documenting their achievements during AME 441.

- **<u>Each group is required to maintain a laboratory notebook and/or binder</u>.** The notebook should be a record of the design process. Raw data, calculations, construction and set-up drawings, uncertainty analysis, etc., should all be contained in this notebook. Highlight problems encountered and how they were solved. **The notebook should be kept neat and legible so that an individual assigned to take over the project at a later time can easily continue the project.** In the back of the notebook, a log of hours spent on the project for each group member should be detailed. With each entry, a brief description of what was done at particular times should be listed as well. Noting the hours logged will help to create a plan of corrective action if/when it appears that time or effort is running short. **This notebook is to be submitted with the final report and will be graded.**

- **<u>The Final Report is due Friday, May 8th before 5pm</u>. Each group is required to submit *one* final report. Late reports will be penalized (-10% per day, including the weekend).** The *suggested* format for the final report can be found in Appendix D.

<u>INCLUDE YOUR GROUP #, DATE, TITLE AND NAMES OF THE AUTHORS ON ALL ASSIGNMENTS</u>

Appendix A: Literature Review

File name: GroupXX_literature_review.pdf

The "literature review" is a document that summarizes the state of current knowledge on your chosen project topic. The literature review should contain numerous *scholarly* references and present the tools you will use to formulate your project proposal. If successfully completed, having this document will facilitate constructive project discussions during the proposal writing process. In fact, this will likely end up being the majority of your proposal introduction. **To complete this assignment, you will need to have formed your project group and decided on your project topic before the beginning of the semester.**

<u>This assignment is due on the **FIRST DAY OF LECTURE** so we can begin the semester immediately!</u>

<u>Suggested Format</u>

- **Cover Page:** Includes group members, potential project title and a one paragraph abstract
- **Topic Summary** (1-2 pages): Discuss why this project is important. Why do we care about this topic? Include the state of current knowledge and what you propose to improve. You should also highlight anticipated design challenges and the technical knowledge that will be required to complete your project. Think back to the AME 441 discussion given at the end of Mech-Op – how will you answer all of the questions required needed to create a successful project proposal?
- **Literature Review** (2-3 pages): In this section, summarize key resources you intend to use during your project. What knowledge was gained from each reference and how will it help formulate your proposal? Don't just write a list of papers and a sentence for each; condense your research into a clear and informative *narrative*.
- **Reference List**: References should be *scholarly* (*i.e.* Journal articles, conference papers, books, etc. *NO INSTRUCTABLES!*) and sufficient to demonstrate a purposeful investigation of your topic. Don't stop with one or two good papers; look at what *they* referenced and take your investigation one step further. Present the references list in a professional format, i.e. AIAA.

<u>**INCLUDE YOUR GROUP #, DATE, TITLE AND NAMES OF THE AUTHORS ON ALL ASSIGNMENTS**</u>

Appendix B: Suggested Proposal Format

File name: GroupXX_proposal.pdf

Section Title	No. of Pages
1. Introduction/Historical Background	1
2. Theory/Basic Equations	1-3
3. Experimental Setup/Procedure (including a sketch of the apparatus)	2-4
4. Cost Estimate	1
5. Timetable	1
6. Reference List	1

The objective of the proposal is to convince the reader that your project will provide useful information and can be successfully completed within the time, budget, and other given constraints. A proposal isn't meant to present sweeping, general knowledge. It is intended to be a concise document limited in scope to the specific project under development. **The proposal should be no more than 10 pages of typed single-spaced text.** Although short in length, the proposal must be thorough. The reader must be convinced that you have sufficiently researched your topic and that you have sufficient understanding to produce meaningful results. Reference previous and current work and give legitimate reasons for the goals you've chosen and the testing you'll perform. **Your project goal must be explicitly stated.**

The proposal also must present a clear picture of how you are going to conduct your experiment. Calculations and results are required which enable an intelligent preliminary design. Additionally, it is highly important, and required, that the proposal contain an estimate of your expected results. Determine what you will need to both produce and capture *meaningful* data. What facilities and equipment will you be using? How large will your device be? What are the important parameters? What kind of data will be taken? **You should have researched your topic in enough detail and performed initial calculations to be able to quantitatively answer these types of questions. Include a sketch of the proposed set-up along with calculations, graphs and figures that will help explain what you will do.**

The cost estimate must provide an accurate account for the ***total*** cost of your project. It should include all equipment, devices, materials, etc. that are required to perform and complete your experiment. This should be presented in a tabular format and an example is provided on Blackboard. A clear distinction must be made between the devices and materials that are currently available in the AME Lab and what needs to be purchased using your allocated AME 441 budget.

The timetable should be presented as a Gantt chart, highlighting the project milestones required for completion, the resources available, and the course deliverables due throughout the semester. The Gantt chart should contain milestones which are broken down into various sub-tasks. All tasks need to be assigned to individual group members. Ensure that this is readable so the proposed timeline can be assessed. An example is provided on Blackboard.

Write your proposal in a manner which can be easily followed by a competent engineer even if they are not a specialist in your project's field. A good rule is to define any terms or concepts that you were not familiar with before starting your literature search. As a test, have one of your classmates (not a group mate) read your proposal to see if they understand and can envision what you want to do!

Appendix C: Progress Report Format

File name: GroupXX_progress_report_N.pdf

Progress reports should be written in third person past tense, as with all technical communications. The task of writing the progress report for the group should be distributed evenly between the group members. These reports will be graded primarily on content; however, professional quality documents are still the expectation. Progress reports should ideally be no longer than 5 pages.

Each progress report will have associated deliverables and project milestones. Failure to meet these progress requirements will have a *severe* impact (i.e. >50% deduction) on your progress report grade. These documents are the primary record of your progress through the semester.

Progress Report 1: Due February 28th before 12pm

Project Milestones:

- Completed experimental / hardware design
- Identification of all essential project components
- Issues identified in the proposal have been resolved

Deliverables:

- Drawings that have not been previously been approved must be submitted with the proposal for approval. *All construction drawings must be completed and approved with submission of this report.* This progress report is the last time to seek approval for drawings before the machining scheduling deadline.
- Orders for enabling components that have not yet been placed must be submitted with the proposal for approval. Enabling components includes items essential for project completion such as sensors, non-stock hardware, etc. If components have been ordered already, list them along with their estimated lead time.

Progress Report 2: Due March 27th before 12pm

Project Milestones:

- Project is under construction and substantial integration has been completed
- Issues identified in Progress Report 1 have been resolved

Deliverables:

- Preliminary data and analysis. This should/could include calibration data for sensors, results from mechanical integration, results from complex manufacturing, etc. Progress should be quantitative and specific goals will be discussed on a group by group basis.
- Documented integration of project components and identification of any modifications required beyond the initial design.

Progress Report 3: Due April 17th before 12pm

Project Milestones:

- Project integration is complete
- Issues identified in Progress Report 2 have been resolved

Deliverables:

- **PROJECT DATA.** This progress report requires you to have data that directly relates to your research question. You must have a functional device / experiment.
- Test matrix for the remainder of the semester. What is your test plan and how will you use the remaining weeks of the semester to provide a concrete answer to your "research question"?

All progress reports should include the following:

- **Cover Page:** Project Title, Group Members, Group Number, Date Range and one paragraph project abstract
- **Progress Update**: The main contents of the progress report. Specifically detail what was accomplished during the previous three weeks. Include calculations, descriptions of designed components, drawings etc. – any and all information helpful to assessing your progress. If you have acquired data, present results and discuss their meaning. This is what you've ***done*** and should be presented in a *professional*, third person past tense format.
- **Project Setbacks**: What issues or problems were encountered? Don't just list problems – you also need to present a path forward. Include what happened, plans for mitigation and the ultimate effect on your timeline. **Note that machining, shipping and other delays do *not* count as project setbacks. These inevitabilities should have been considered in your project planning.**
- **Future Work**: A concise explanation of the tasks to be performed during the upcoming progress period. Identify group members who are responsible for completing these tasks.
- **Updated Gantt Chart**
- **Peer Evaluation Forms**: *Each* group member is required to submit a confidential Group Evaluation form with each progress report. A separate submission box will be provided in RRB 101. The evaluation form is given in **Error! Reference source not found.**.

Appendix D: Suggested Format for Final Report

File name: GroupXX_final_report.pdf

Section Title	No. of Pages
Abstract (on title page)	1
Introduction	2-4
Experimental Technique	2-4
Results	3-6
Discussion	2-3
Conclusion	1
References	1
Appendices	No more than 5

Note: No more than 20 pages of typed single-spaced text, not including appendices. Look at long-format journal articles for the tone and style required of a professional project report.

Assume the reader knows nothing about your work! The final report should stand alone with no references to your proposal or progress reports. (You may of course reference other papers or books.) The introduction should state the goal/objective, give some historical background and/or the state of the art of the subject, and any theoretical derivations pertinent to the project.

The experimental technique section should give the important details of the set-up; **a schematic must be included** as well as the procedure. Mention all the equipment used, type of data taken, how the data was processed, etc. When writing this section, keep in mind that you want to give the reader the impression that you were careful when you took your measurements and your data is reliable. Towards this end, you can mention your estimates of uncertainty without going into excessive detail. (Do not clutter the main body of your final report with lengthy uncertainty derivations. Detailed uncertainty analysis *should* be in your lab notebook and may be included in an appendix if further explanation is required in your report)

Additionally, do not go into a narration of all the trouble you went through to get to your final set-up! While troubleshooting does take up a *tremendous* amount of time, the process isn't necessarily "report worthy." Describe what worked and why.

Results and Discussion can be two separate sections or combined. It can even be subdivided into the different aspects of the investigation. The only requirement is that you present your results and then discuss them in a manner that can be easily followed. This is by far the most important part of your report and should be worded carefully to enhance the virtues of your work.

In the Conclusion, assess whether you have achieved your goal/reached your objective as stated in the Introduction. You may restate your important findings briefly. Also, you could suggest an alternate approach to solving the same problem or, talk about improvements to the work and applications.

Appendix E: KIEUL Senior Design Expo

The KIEUL Senior Design Expo is typically scheduled for late April. Your group must be in attendance and you will present to the Viterbi community. This is your chance to show-off! What did you accomplish this semester and where will you go from here?

Posters are expected to be of professional quality and will be printed by the AME department. Think of your poster as a backdrop for a discussion you would have with an individual. What do you need to discuss your senior project? Posters should include group names, a project abstract, key data / results, diagrams, etc. Several past examples are available for viewing in the AME Lab. If possible, you are also encouraged to display your project and demonstrate its functionality.

Further details for both poster printing as well as creation tips will be given later in the semester.

Note: It is strongly encouraged that senior design groups participate in the KIEUL Senior Design Expo in the Spring. Everyone in AME will have a poster as well as poster session experience – why not try to win some prizes!?

Appendix F

AME-441 Senior Projects Laboratory

<u>Oral Presentation Grade Sheet</u>

Group # ______________ Date: ________________________

Title of Project: ____

Name(s) of Speakers: ____

Grade for each category is based on the scale shown below.

	Grade	Comments
1. **<u>Organization and Delivery</u>** (Was project clearly defined? Continuous thoughts? Speech easy to understand? Visual aids: timing, sufficient number of slides, neatness, clarity, etc.)	______ (35)	
2. **<u>Technical Content</u>** (Scientific merit appraised? Symbols and parameters defined? Technically sound arguments? Logical methods of experimentation and evaluation? Etc.)	______ (50)	
3. **<u>Overall Performance</u>** (Did presentation hold audience's attention? Questions answered, etc.)	______ (15)	
<u>Total Score</u>	______ **(100)**	

Appendix G: Faculty List – ASTE Department

Name	Area of Interest	Office	Email
Prof. D. Erwin	Spacecraft propulsion, optics and optical instruments, kinetics of gases and plasmas	RRB 222	erwin@usc.edu
Prof. D. Barnhart	Spacecraft design, bus architecture, mission concepts and testing		barnhart@serc.usc.edu
Prof. M. Gruntman	Spacecraft and space mission design, propulsion, space physics, space sensors and instrumentation, space plasmas.	RRB 224	mikeg@usc.edu
Prof. J. Kunc	Atomic and molecular interactions, transport of particles and radiation in non-equilibrium gases and plasmas, molecular dynamics, classical and statistical thermodynamics.	RRB 230	kunc@usc.edu
Prof. A. Madni	Complex system analysis and design; complexity management; socio-technical systems; modeling and simulation; model based engineering; engineered resilient systems; integration of humans with adaptable systems; STEM education simulations/games.	RRB 201	azad.madni@usc.edu
Prof. H. Schorr	Artificial intelligence, advanced computing systems, information technology		schorr@isi.edu
Prof. F. Settles	Engineering management, integrated management and design, quality management, manufacturing for biomedical/biotechnical applications	GER 2126C	settles@usc.edu
Prof. J. Wang	Electric propulsion, space environment and spacecraft interactions, particle simulation algorithms for gases and plasmas, microfluidics	RRB 216	josephjw@usc.edu

Appendix H: Faculty List – AME Department

Name	Area of Interest	Office	Email
Prof. I Bermejo-Moreno	Computational fluid mechanics, turbulent flows, fluid structure interaction, combustion, hypersonic propulsion, high performance computing	RRB 215	bermejom@usc.edu
Prof. C. Campbell	Two-phase flow, flow of granular material, heat transfer, slurry flows, fluidized beds, comminutron, particle fracture	OHE 400E	campbell@usc.edu
Prof. J. Domaradzki	Computational fluid mechanics, environmental and geophysical fluid mechanics, turbulence	RRB 215	jad@usc.edu
Prof. F. Egolfopoulos	Aerodynamic and Kinetic Processes in Flames, High-speed air-breathing propulsion, Microgravity Combustion, Mechanisms of Combustion-Generated Pollutants, Heterogeneous Reacting Flows, Conventional and Alternative Fuels, Detailed Modeling of Reacting Flows, Laser-Based Experimental Techniques	OHE 400B	egolfopo@usc.edu
Prof. H. Flashner	Dynamics and control of systems, control of structurally flexible systems, analysis of nonlinear systems, biomechanics	OHE 430E	hflashne@usc.edu
Prof. R. Ghanem	Risk assessment and mitigation, computational mechanics and computational stochastic mechanics, dynamics and identification, inverse problems and optimization under uncertainty, multiscale modeling; applications of these to problems in science and engineering	KAP 254	ghanem@usc.edu
Prof. S. K. Gupta	Computer Aided Design, Manufacturing Automation, and Robotics	OHE 430G	skgupta@usc.edu
Prof. Y. Jin	Collaborative engineering, design theory and methods, knowledge-based design and manufacturing systems, intelligent agents for engineering support	OHE 400D	yjin@usc.edu
Prof. E. Kanso	Dynamical systems, animal hydrodynamic propulsion	RRB 214	kanso@usc.edu
Prof. M. Luhar	Turbulence, Environmental Fluid Mechanics, Flow-Structure Interaction	OHE 400C	luhar@usc.edu
Prof. P. Newton	Nonlinear dynamical systems, fluid mechanics, vortex dynamics, probabilistic game theory, mathematical modeling of cancer metastasis	RRB 221	newton@usc.edu
Prof. M. Oussama Safadi	Structural Dynamics, finite element, stress analysis, fracture mechanics	OHE 430L	
Prof. N. Pérez-Arancibia	Mechatronics, robotics, feed-back control, signal processing, dynamics, applied optics, fabrication of microrobots, and biologically inspired engineering	OHE 430I	perezara@usc.edu
Prof. P. Ronney	Combustion, micro-scale power generation and propulsion, biophysics and biofilms, turbulence, internal combustion engines and control systems, low-gravity phenomena, radiative transfer	OHE 430J	ronney@usc.edu
Prof. S. Sadhal	Drops and bubbles in acoustic fields, thermo-capillary flows with drops in low gravity, heat conduction in composite solids	OHE 400G	sadhal@usc.edu
Prof. G. Shiflett	Kinematics and dynamics of mechanical systems, computer-aided design, optimal design techniques, micro-electromechanical systems	OHE 430F	shiflett@usc.edu
Prof. G. Spedding	Geophysical fluid dynamics, animal aero- and hydrodynamics, turbulence	OHE 430B	geoff@usc.edu
Prof. A. Uranga	Fluid mechanics, aerodynamics, computational fluid dynamics, aircraft design, airframe-propulsion system integration, boundary layer ingestion	RRB 218	auranga@usc.edu
Prof. B. Yang	Dynamics, vibration and control of mechanical systems, distributed-parameter systems, modeling and control of space structures, computational mechanics	OHE 400F	bingen@usc.edu