AME 441aL & AME 441bL Senior Projects Laboratory
Spring 2024

Laboratory: **M 10:00 – 12:50**
BHE 310

Lectures: **M 8:00-9:20**
BHE 310

Professors: Dr. Matthew Gilpin
OHE 50 H
gilpin@usc.edu

Office Hours: See Piazza for Lab & Staff Availability

Laboratory Technicians: BHE 310, (213) 740-4304

Jeffrey Vargas	Rodney Yates	Usiel Ulloa	Alex Flores
vargasje@usc.edu	rodneyya@usc.edu	uulloa@usc.edu	floresal@usc.edu

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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:

This Spring, 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!

AME 441b: Returning Projects

Welcome back! 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.

All 441 Participants:

You are only required to register for 3 hours of lab so that your busy Senior schedules can be accommodated. **HOWEVER**, substantially more laboratory time will be required for you to successfully complete your projects. A reasonable estimate is 8 hours per week of lab time (per student, when things are going well), so budget your time accordingly. It will be *your* responsibility to work with your group and establish regular work times prior to the semester. Please see Piazza for laboratory availability.

We are sharing the AME Instructional Labs this Spring with AME 341b, AME 443, AME 504, Facilities Construction Crews, etc. ***It will be BUSY.*** Please take advantage of the lab openings specifically designated for AME 441 and be respectful of the BHE Lab Staff. AME 441 is only ***one*** of their many responsibilities.

Senior Projects in Aerospace and Mechanical Engineering
Spring 2024

* all dates are subject to change *

I. Introduction

The aim of this course is to complete an original project of your own creation which you will shepherd 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 work means that one's ingenuity and initiative are a major factor in success.

Students work in groups of **four** 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, the project needs to be scoped to fit in a 15-week semester.

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

The AME 441 schedule compresses an entire design project into a single semester. So, we need to hit the ground running! You will have an assignment due the **<u>first day of lecture</u> (12pm Monday, August 21st).** 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 you 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, September 1st before 5pm**. 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 *<u>cannot</u>* begin until project approval has been given. The required format for this can be found in Appendix B: Suggested Proposal Format

Two written progress reports will be due during the semester (Friday Sept. 29th and Friday Oct. 27th by 5pm). 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 give one formal **oral presentation** on their work to the rest of the class; presentations will take place during the lecture section starting mid- to late-semester.

Each student group will be required to present a poster of their project to faculty and invited guests from industry. This **poster session** is tentatively scheduled for Friday, December 1st and is a great opportunity to show everyone else the amazing things you've accomplished in AME 441! It is also great preparation for the Viterbi Senior Design expo which is held in the Spring. 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 **Wednesday, December 6th before 9am**. Students will be evaluated on the quality and content of their reports and presentations as well as their performance throughout the semester; this includes cleanliness of work areas, adherence to lab safety protocol, and attendance/participation in scheduled meetings.

Document Submission

TurnItIn will be used for submitting all assignments. This includes the Literature Review, Proposal, Progress Reports, and Final Report. Look in \\Blackboard\Assignments\ for document submission links. **Peer Evaluations** will be submitted online via a Google Form.

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_proposal.pdf
- G42_progress_report_1.pdf
- G42_progress_report_2.pdf
- G42_final_report.pdf

II. AME Lab Procedures and Protocol

Safety and Space Management

- ***CLOSED-TOE SHOES, LONG PANTS AND APPROPRIATE SHIRTS* ARE REQUIRED IN THE LAB AT ALL TIMES. *NO EXCEPTIONS!*** Shoes need to provide protection; hence, “Toms”, boat shoes, flats, slippers, etc. do not qualify. Pants need to be pants **NO EXPOSED ANKLES**. Shirts need to **COVER** shoulders and mid-sections.
- 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 lab work can only be performed during lab times when teaching and lab staff are present.
- Store your personal belongings out of walking paths; *e.g.*, under work tables. 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.
- Files saved to a **\JStude** directory will be safe for the semester. *All 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.
- Usage of the printers in the AME Lab are for AME 441 documents only. No exceptions.

III. Facilities

The AME Lab in BHE has served *decades* of AME 441 classes and is well stocked with most 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, various pressure transducers, low power lasers, thermocouples, etc. So that your group can see what is available, an inventory log will be posted to the course website. Additional information such as vendors and cost are also provided, which might prove useful to your team when writing the proposal. 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).

Recent AME Lab purchases have focused on procuring research-grade equipment that would typically be beyond the budget of a senior project. Some examples include a FLIR A400SC thermal imager, high-speed cameras (KronTech Chronus 1.4 and GoPro Hero Black), and B&K Precision 9115 programmable power supplies. These devices are in limited supply and usage might need to be shared and scheduled with other groups. For a list of all devices and equipment that is available in the lab, see the Inventory Log posted under \\Blackboard\Content of our course webpage.

In addition to basic scientific equipment, the BHE labs have larger test facilities. The AME Lab has a low-turbulence, open-circuit wind tunnel in BHE 301. The test section measures 46 cm x 46 cm x 91 cm and can provide freestream velocities from 3 to 35 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 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 RRB 107. The test section of this water channel measures 18 cm x 20 cm x 91 cm and has a test velocity range of 5 to 15 cm/s. Flow visualization can be performed through the transparent, acrylic test section walls. Finally, in the basement of BHE there is a 16-inch diameter, 24-inch long, cylindrical vacuum chamber with an 80 mTorr base pressure and a 19-inch long thrust stand capable of +/- 1.25 mm of displacement (200mN). 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 water channel in RRB 107. The test section of this water channel has a cross-section of 91 cm x 14 cm, and a usable length of approximately 3.5 m. Test velocities range from 12 to 40 cm/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.

Groups will have access to all software available via the Viterbi Virtual Desktop Interface (VDI) including Siemens NX or SolidWorks as well as the software available on the SAL computers via a remote desktop. Additional software will be considered on a project-by-project basis.

IV. Manufacturing

All projects 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 laser cutter with a 60 cm x 30 cm bed that is capable of cutting 2D shapes from acrylic, balsa wood, and thin plywood. When designing parts for AME 441, using a laser cutter should be your ***FIRST*** thought. Unlike other manufacturing facilities, the laser cutter can produce *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 has the following 3D printers: Prusa i3 MK3S+, Markforged Onyx One, Markforged Mark Two. 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 during the semester 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. Make sure to talk to the AME staff before you assume something can be 3D printed. All 3D printing jobs need to be scheduled through Jeffrey Vargas or Usiel Ulloa.

Finally, the AME lab has a full machine shop enabling in-house manufacturing. Rod Yates and Alex Flores have 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 or Alex Flores and will be completed on a first-come first-served basis.

For all of the above facilities, manufacturing will **NOT** be scheduled until the part and assembly drawings have been approved by both "Engineering" (AME 441 Instructors) and "Manufacturing" (Jeffrey Vargas or Usiel Ulloa: Laser Cutter & 3D printer, Rod Yates or Alex Flores: 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, submitted as a set (e.g. parts and assembly they belong to), computer generated using the provided templates and have at a minimum:

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

Additional manufacturing facilities are available include the Baum Maker Space 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. The approval process for manufacturing at these facilities is similar to what is required at the BHE facilities.

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 can 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 *reusable 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 Baum Family Makerspace (BFMS), 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 Appendix F. 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. To facilitate this, and provide guidance on each group's project, conferences with one or more instructors will be held weekly. During these conferences, current work and problems are to be discussed and evaluated. The instructors should be notified immediately of any difficulties in the project, 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.

All students are required to attend **all** oral presentations during their registered lecture section. Attendance will be recorded. A 10% penalty will be applied to your oral presentation score for each absence. Arriving late or leaving early counts as an absence.

Each group is required to keep a digital 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 added emphasis has been put 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 continue your project based solely on the information contained within. A lab notebook *shall* be a well kept and formatted digital document. Simply submitting your groups google doc folder doesn't count.

All students must complete 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.

Lab performance will be evaluated based on the scale presented below.

Score	Requirement
0	Does not participate and/or has no regards for own safety or safety of others in the lab.
1	Present in lab, but does not offer anything towards project progress, neglects to answer technical questions
2	Demonstrates adequate preparation: Offers straightforward information, without elaboration or very infrequently • Demonstrates sporadic involvement with the progress of the experiment.
3	Demonstrates good preparation: Contributes well to discussion in an ongoing way, responds to other group members' points, thinks through own points, questions others in a constructive way. • Demonstrates consistent ongoing involvement with the progress of the experiment.
4	Demonstrates excellent preparation: Contributes in a very significant way to ongoing discussion: keeps analysis focused, responds very thoughtfully to other group members' comments, contributes to the cooperative argument-building, suggests alternative ways of approaching material and helps team members analyze which approaches are appropriate, etc. • Demonstrates ongoing very active involvement with the progress of the experiment.

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	15
Oral Presentation	15
Poster Presentation	10
Lab Performance	15
Final Report	35
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	W January 10th, 5pm
Project Proposal	W January 24th, 5pm
Progress Report 1	W February 14th, 5pm
Progress Report 2	W March 20th, 5pm
Progress Report 3	W April 10th, 5pm
Oral Presentations	Post Spring Break, TBD
Poster Presentation	Post Spring Break, TBD
Laboratory Notebook	**M May 6th, 8 am**
Final Report	**M May 6th, 8 am**

- **The first deliverable is the Literature Review**. This is due on the **FIRST WEEK.** Only one document per group is required. 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 detail is given in Appendix A.

- **The second deliverable is the Project Proposal.** At a minimum, the proposal should follow the guidelines provided in Appendix B. Only one document per group is required. Proposals are due **Wednesday, January 24th by 5pm**. 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.

- **Three written progress reports will be due during the semester (W February 14th , W March 20th, & W April 10th).** 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 **Group Evaluation Form** online via a Google Form. The link will be provided on Blackboard. Responses will be kept confidential and are intended to assess the involvement of each group member and the group dynamics of each team. A 10% penalty will be given to your progress report grade if no group evaluation form is submitted.

- **Oral presentations will be given in person during the scheduled lecture sessions** post 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.

- **<u>A poster presentation</u>** will be given at the end of the semester coinciding with at Viterbi-wide senior projects / research symposium. Details for this session will be given when Viterbi announces their end of the semester event schedule.

- **<u>Each group is required to maintain a digital laboratory notebook</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 well organized so that an individual assigned to take over the project at a later time can easily continue the project.** A log of hours spent on the project for each group member shall be available and 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.** The notebook shall be a well kept and formatted digital document. Simply submitting your group's Google Drive folder doesn't count as a notebook.

- **<u>The Final Report is due Monday, May 6th before 8am</u> in keeping with the University Final Examinations Schedule. Each group is required to submit *one* final report. Late reports will be penalized (-10% per day).** 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>

VIII. Statement on Academic Conduct and Support Systems

Academic Integrity

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the USC Student Handbook. All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. (Living our Unifying Values: The USC Student Handbook, page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. (Living our Unifying Values: The USC Student Handbook, page 13).

Course Evaluations

Course evaluation occurs at the end of the semester university-wide.

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-2850 or otfp@med.usc.edu

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.

Appendix A: Literature Review

File name: GXX_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 WEEK OF CLASS** 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 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*. Use figures and sketches from your cited sources to describe what has been observed previously; don't send the reader on a scavenger hunt.
- **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 (*e.g.*, AIAA).

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

Appendix B: Suggested Proposal Format

File name: GXX_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: GXX_progress_report_#.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 W February 14th before 5pm

<u>Project Milestones:</u>

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

<u>Deliverables:</u>

- CAD model of your completed experimental design with all components labeled
- Exploded assembly drawing with detailed BOM.
- In the BOM all components must be identified with their location, order status and lead time.

  Include stock lab components in this list and confirm their existence.
- Purchase orders for all enabling components which have not yet been placed.

Progress Report 2: Due W March 20th before 5pm

<u>Project Milestones:</u>

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

<u>Deliverables:</u>

- 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.
- 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 “design question”?

Progress Report 3: Due W April 10th before 5pm

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 should have a functional device / experiment

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 and budget**
- **Peer Evaluation Forms**: *Each* group member is required to submit a confidential Group Evaluation through Google Forms.

Appendix D: Suggested Format for Final Report

File name: GXX_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 derivations. For example, 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.

An updated budget analysis should also be available as one of the appendices. It is important to determine if the project you worked on for the entire semester went over budget and if so why.

Appendix E: Poster Session

A poster session is tentatively scheduled on the last day of class, December 1st – time/place TBD. Your group must be in attendance and will present your project to your classmates, AME undergrads, AME faculty and invited guests. Your team will be rated on the quality of the poster as well as your "sales pitch" and ability to discuss the technical merits of your project. This is your chance to show-off! What did you accomplish this semester and where will you go from here? Food will be served!

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: Oral Presentation Grade Sheet

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	Email
Prof. D. Erwin	Spacecraft propulsion, optics and optical instruments, kinetics of gases and plasmas	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.	mikeg@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.	azad.madni@usc.edu
Prof. J. Wang	Electric propulsion, space environment and spacecraft interactions, particle simulation algorithms for gases and plasmas, microfluidics	josephjw@usc.edu

Appendix H: Faculty List – AME Department

Name	Area of Interest	Email
Prof. I Bermejo-Moreno	Computational fluid mechanics, turbulent flows, fluid structure interaction, combustion, hypersonic propulsion, high performance computing	bermejom@usc.edu
Prof. Y. Chen	Novel additive manufacturing process and machine development for direct digital manufacturing and 3D printing; New methodologies and techniques for reliable and fast manufacturing process based on process modeling and control; Design methods and computational tools for direct digital manufacturing enabled products and applications	yongchen@usc.edu
Prof. J. Domaradzki	Computational fluid mechanics, environmental and geophysical fluid mechanics, turbulence	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	egolfopo@usc.edu
Prof. H. Flashner	Dynamics and control of systems, control of structurally flexible systems, analysis of nonlinear systems, biomechanics	hflashne@usc.edu
Prof. A. Ghadami	Dynamical systems and control, Data-driven methods, Multi-agent systems	ghadami@usc.edu
Prof. S. K. Gupta	Computer Aided Design, Manufacturing Automation, and Robotics	skgupta@usc.edu
Prof. Y. Jin	Collaborative engineering, design theory and methods, knowledge-based design and manufacturing systems, intelligent agents for engineering support	yjin@usc.edu
Prof. E. Kanso	Dynamical systems, animal hydrodynamic propulsion	kanso@usc.edu
Prof. M. Luhar	Turbulence, Environmental Fluid Mechanics, Flow-Structure Interaction	luhar@usc.edu
Prof. N. Maghsoodi	Solid mechanics; Multiscale bio-dynamics; Soft materials; Bio-solid mechanics in medicine and biology; Bio-inspiration	maghsoodi@usc.edu
Prof. P. Newton	Nonlinear dynamical systems, fluid mechanics, vortex dynamics, probabilistic game theory, mathematical modeling of cancer metastasis	newton@usc.edu
Prof. Q. Nguyen	Highly dynamic robotics, control of legged robots, nonlinear control, real-time optimal control, trajectory optimization, reinforcement learning of robotics	quann@usc.edu
Prof. A. Oberai	Computation and Data Driven Discovery, data- and physics-based models to solve engineering problems	aoberai@usc.edu
Prof. N. Pahlevan	Biofluid Dynamics, Fluid-Structure Interaction, 3D quantitative flow visualization, hemodynamics, Bio-inspired design, Mathematical physiology	pahlevan@usc.edu
Prof. C. Pantano-Rubino	Turbulent flows with special focus to combustion, fluid-structure interaction and numerical methods for accurate simulation of the Navier-Stokes equations in simple and complex domains	pantanor@usc.edu
Prof. A. Penkova	Transport processes in biological and integrated systems.	penkova@usc.edu
Prof. P. Plucinsky	Solid mechanics, material science and mathematics, material behavior	plucinsk@usc.edu
Prof. I. Puri	Strained partially premixed counterflow flames leading to energy efficient furnaces and gas turbines; Thermal management of data centers; Thermomagnetic convection; Nanoparticle synthesis and preparations for sensors and supercapacitors; Magnetic 3D printing and biologically printing cells.	vpres@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	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	sadhal@usc.edu
Prof. G. Shiflett	Kinematics and dynamics of mechanical systems, computer-aided design, optimal design techniques, micro-electromechanical systems	shiflett@usc.edu

Prof. G. Spedding	Geophysical fluid dynamics, animal aero- and hydrodynamics, turbulence	geoff@usc.edu
Prof. F. Udwadia	Dynamics and control, nonlinear dynamical systems, applied mathematics, mechanics and mathematics, structural and analytical dynamics, system identification, optimization, collaborative engineering, engineering management	fudwadia@usc.edu
Prof. A. Uranga	Fluid mechanics, aerodynamics, computational fluid dynamics, aircraft design, airframe-propulsion system integration, boundary layer ingestion	auranga@usc.edu
Prof. B. Yang	Dynamics, vibration and control of mechanical systems, distributed-parameter systems, modeling and control of space structures, computational mechanics	bingen@usc.edu
Prof. H. Zhao	Mechanics-driven manufacturing	hangbozh@usc.edu