AME 441aL Senior Projects Laboratory
Fall 2014

Lectures:	**T 12:30 – 1:50** ZHS 159	**W 12:30 – 1:50** KAP 165	**T 9 :30 – 11 :50** GFS 116
Laboratories:	**TTH 9:00 – 11:50** BHE 310	**MW 2 – 4:50** BHE 310	**MW 9:30-12:20** BHE 310

Professors:	Dr. C. Radovich RRB 202 (213) 740-5359 radovich@usc.edu	Dr. P. Sellappan BHE 110 (213) 740-4304 psellapp@usc.edu	Benjamen Bycroft BHE 317 (213) 740-4304 bycroft@usc.edu
Laboratory Manager:	Denise Galindo BHE 301, (213) 740-4304 dgalindo@usc.edu		
Laboratory Technician:	Rodney Yates BHE 310, (213) 740-4304 rodneyya@usc.edu		
Teaching Assistants:	(Information available on Blackboard)		

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.

Atchison, S. & B. Kennemer. *Using Microsoft Project 2010*, Que Publishing.

Important note to all students registered for AME 441aL:

This semester we have over 150 students registered for the course. The class is divided into three sections. One section meets in the lab on Tuesday and Thursday mornings with a lecture on Tuesday. Another section meets in the lab on Monday and Wednesday mornings with a lecture on Tuesday. And the other section meets in the lab on Monday and Wednesday afternoons with a lecture on Wednesday. **Note, you will be working in a group and all group members must be registered in the same lecture/lab section.** You should arrange your group before you register.

The lecture section will be used to discuss course material, introduce and review concepts, and for the oral presentations given by each group. You must attend the lecture section for which you are registered. You are also expected to be in the lab during your registered time slots, where weekly verbal reports and conversations will take place. Attendance during the oral presentations will be taken and points subtracted for each absence after the first; late arrivals are the same as a no show (1 μs = late).

The semester will start with the submission of a proposal for you senior design project. **You will focus on your project for the entire semester.** Before writing the proposal, students must arrange themselves into a group of **three or four** students. Students will work together in lab for the entire semester and present their work together during the lecture section. Thus, **the members of each group must be enrolled in the same lecture and lab section** as stated above. No exceptions.

Senior Projects in Aerospace and Mechanical Engineering
Fall 2014

I. Introduction

The aim of this course is to introduce the student to some of the basic ideas of experimental work. The emphasis is on project work where one's ingenuity and initiative are a major factor in success. It is as close as one can get, in a teaching situation, to the responsibilities of an industrial research project. It gives the student a taste of the type of problem(s) she/he is likely to encounter upon leaving school.

Students work in groups of **three or four** (3 - 4) on a project of their choice for the entire semester. Ideally, topics for these projects are provided by the students themselves. **Think about where you want to be next year and make this project the centerpiece of your academic and budding professional portfolio.** However, projects can be selected from a number of ideas suggested by the faculty and will be provided to you near the end of July. The extent of the subjects covered is quite broad. Project topics have ranged from such traditional areas as fluid dynamics, structural mechanics, heat transfer, and dynamic control, to rather obscure and arcane studies on fishing line motion, plant growth in varying pressure environments, anti-lock brakes and the like. The primary requirement in the selection of a topic is that the student must be interested in it. More pragmatically, design, construction and testing should be accomplished within one semester given the constraints of the lab facilities and a set financial budget.

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

Before work can begin on any project a formal written proposal, including a timetable and budget, is required. The preliminary proposal is due **Friday, September 5th at 12 pm in RRB 101**; this will be returned promptly so that comments and required changes can be addressed. The final proposal is to be submitted by **Friday, September 12th at 12 pm in RRB 101**. The preliminary proposal might be approved as-is, in which case you could begin working immediately. In any case, work on the project cannot begin until approval has been given.

Starting Friday, October 3rd written group progress reports are due every 3 weeks at 12 pm in RRB 101. These will be graded not only on technical content and progress made, but also on quality, clarity and professional format. During each lab session, a few groups will be chosen to describe their progress orally to the instructors.

One **Final Report** of publishable quality will be required by each *group* at the end of the term on **Friday, Dec. 5th before 5pm in RRB 101**. Also, each group will give one formal presentation on their work to the rest of the class; presentations will take place during the lecture section. Students will be evaluated upon the quality and content of their reports and presentation as well as their performance in the laboratory; this includes cleanliness of work areas and attendance in the scheduled lecture/laboratory sessions.

II. AME Lab Procedures and Protocol

Safety and Space Management

- ***CLOSED-TOE SHOES*** **ARE REQUIRED IN THE LAB AT ALL TIMES.** Shoes need to provide protection; hence, slippers do not qualify.
- Long pants are **highly** recommended; at a minimum, knee-length shorts are required.
- 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 area. 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 the BHE 301 presentation room. These resources are to be shared and ***are not to leave the BHE 301 presentation room.***

Supply Room and Device Access

- Access to the BHE 301a supply room is allowed only with approval of an AME 441 staff member.
- 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 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 some 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 allowed. Be prepared to thoroughly present and explain your design in order to facilitate the approval and scheduling of part fabrication/machining.

Computer/Printing Rules

- Do ***not*** customize any computer workstations. This includes modifying the desktop, any/all computer settings, installing any software without staff approval.
- Save files **only** in the following directory: **D:\home\JStude**. *Files in 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**.
- When done with a computer workstation, log off and turn off the monitor.

III. 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. The turbulence level is less than 0.25%. It is equipped with two force balances, both 2 components: 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 water channel is also available for experiments in water. The low-speed BHE water channel, located in room BHE 110, was constructed as part of a 441 project a few years ago. 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 is also possible through a multifunction DAQ device and LabVIEW. 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 Dr. Prabu Sellappan before including it in their project proposal.

Other facilities available for use are: a pipe flow apparatus to study convective heat transfer (in pipes); a cross-flow heat transfer apparatus to determine the properties of various heat transfer devices (heat exchangers) mounted in-line; a device for applying precise buckling and bending loads to rods and beams; instrumentation to determine the dynamic vibration of various beam configurations; and an oscillating pendulum apparatus for studying second order system dynamics, and for studying coupled modes of vibration of various compound pendulums. Other small facilities like drop tanks, towing tanks, shock tubes, and vacuum chambers are also available. In the past, some students, working on certain projects, have been granted the use of some of the department's more advanced research facilities.

The AME Lab provides PC's for data acquisition and analysis. Instrumentation is available in the laboratory including low-power lasers, digital image and video recorders, high-speed cameras, hot-wire anemometers, various pressure transducers, etc. If the required instrumentation is not readily available in the lab, they can often be procured from other departments on a loan basis (*e.g.*, a micropipette could be borrowed from the Biology department).

IV. Budget

Each student is allotted approximately $75 for the purchase of expendable materials. The total amount of funding for a project will be based on the budget submitted with the proposal and may exceed this amount if it is deemed necessary for the project's success. A wide selection of hardware, raw materials and tools such as screwdrivers, drills, circular saws, sanders, etc. are already available in the supply room. Should you need to make a purchase, follow the guidelines below:

Prior to making any purchase, approval is required by you instructor. Pre-approval is required if you want to be reimbursed. 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.

Students may make smaller cash purchases and they will be reimbursed upon presentation of an original receipt; again, pre-approval is required for this from your instructor. 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. Cash purchases from these places will not be reimbursed.

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

V. Grading

Grades are based on both individual and group performance. Marks will be assigned to all written reports and the oral presentation. All these are expected to be of a quality that reflects the care and professionalism with which the student conducts her/his work. Requirements for all written reports and a sample grade sheet for the oral presentations are provided in Section V and Appendices A through D. The order of the oral presentations is to be determined by lottery.

Students will be graded on their performance in the laboratory. To facilitate this, as well as to help guide the direction of 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 delayed notification may have an adverse effect on performance assessment. It is essential that these projects are worked on continuously; waiting until the last few weeks will surely be detrimental to your grade.

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. 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 student is required to keep a laboratory notebook as described in Section V. 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 as if you planned to give it to another group for the following year.

Each student must also complete 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 complete grade distribution is detailed in Table 1. This distribution is subject to change.

Table 1. Final Grade Weight Distribution (%)

Proposal	10
Progress Reports	10
Oral Presentation	20
Lab Performance	20
Final Report	40
TOTAL	**100**

VI. Deliverables

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

The first written requirement is the Project Proposal. At a minimum, the proposal should follow the guidelines provided in Appendix A. Only one per group is required. Preliminary proposals are due on **Friday, September 5th at 12 pm in RRB 101.** Early submission of the preliminary proposal is strongly encouraged, since major rewriting is often required for the final proposal to be approved. The deadline for submitting the final proposal is **Friday, September 12th at 12 pm in RRB 101**. It is also recommended that you discuss any ideas and/or approaches with your instructors, TA's and lab staff before and during this process.

It is not uncommon for proposals to be rejected. Students whose projects are not approved will be given an extra week to submit a new proposal but can no longer receive full credit. Work on the project can begin once the project is approved.

A progress report is due every three weeks before 12 pm, starting Friday, October 3rd. Only one per group is required and the contents should follow the suggested guidelines presented in Appendix B. A total of **three** progress reports will be handed in throughout the semester. These will be graded on the amount of progress achieved by the group, as well as clarity in technical communication.

Four Group Evaluation Forms will be submitted during the course of the semester to assess the involvement of each group member. The first three evaluations are due at the same time as the Progress Reports; the fourth evaluation is due with the Final Report. Although the progress reports and Final report are turned in as a group, **each student is required to submit the Group Evaluation Form found in Appendix E**. These forms will be kept confidential. There will be separate drop boxes for the group evaluation forms in RRB 101.

The Final Report is due Friday, December 5th by 5:00 pm in RRB 101. 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 C.

Each group is also required to maintain a laboratory notebook or binder. It should contain all possible methods of solving problems that arise, as well as the details of these problems. Raw data, calculations, construction and set-up drawings, uncertainty analysis, etc., should all be contained in this notebook. **It 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.**

Oral presentations will be given by a few groups each week during the lecture section. The order will be determined by lottery. Presentations will be 20 minutes long, which includes time for questions. The standard visual aid to be used will be a computer with a projector. PowerPoint and Adobe Acrobat Reader will be provided. A sample grade sheet for the oral presentation can be found in Appendix D. On your presentation day, arrive at lecture 15 minutes prior to the start of class (*e.g.*, 9:15 am or 12:15 pm) and upload your file to the class computer.

All documents are to be typed, stapled or clipped, and a hard copy must be submitted. Do **NOT** email reports. The use of fat, three-holed binders is discouraged because, in large numbers, they are cumbersome for us to handle.

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

Appendix A: Suggested Format for Proposal

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)	1-4
4. Cost Estimate	1
5. Timetable	1
6. Reference List	1/2

The objective of the proposal is to convince the reader that your project will provide useful information and can be done within the time, budget, and other constraints given. The knowledge that one stands to gain from it is, of course, not expected to be of the sweeping, general, great-benefit-to-mankind type, but rather to be specific and limited in scope. **The proposal should be no more than 10 pages of typed double spaced text.**

Although short in length, the proposal must be thorough. The reader should be convinced that you know what you are talking about in terms of information currently available on your topic and what you want to do to advance this knowledge. **Your goal must be explicitly stated.** Reference previous and current work and give legitimate reasons for conducting the experiment.

You should also have a clear picture of how you are going to conduct your experiment. Perform rough calculations to enable you to design your apparatus in a logical manner and to estimate, roughly, the magnitude of your expected results; *i.e.*, try to determine what you need by calculation rather than just guessing. What facilities and equipment will you be using? How large will the model be? What are the important parameters? What kind of data will be taken? **You should have researched your topic in enough detail and performed some initial calculations to be able to answer these types of questions. Include a sketch of the set-up as you imagine it will be as well as 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. 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. MS Project should be used to create this schedule; this program is available on the AME Lab computers as well as in all the USC student computer labs. Helpful how-to hints will be discussed during lecture and a tutorial will be available on Blackboard.

Remember to write your proposal in a manner that can be easily followed by a reasonably competent engineer who is not necessarily specialized in your project's field. A good rule is to define any terms or concepts that you were not familiar with before you started your literature search. As a test, have one of your classmates (not a group mate) read your proposal to see if she/he understands, and can picture what you want to do!

Appendix B: Format for Tri-Weekly Progress Report

Title of Project

Group # and Student Names

Progress Report for the Period Starting MM/DD/YY and Ending MM/DD/YY

Progress reports should be written in third person past tense, as all technical communications should be. The task of writing the progress report for the group should be distributed evenly between the group members. These reports will be graded partially on form but mostly on content and the amount of progress you have made in the lab. Note: preparing an oral presentation is not lab progress.

You will write three progress reports throughout the semester. **These are due by 12 pm in RRB 101 on the following Friday's: October 3rd, October 24th and November 14th.**

In general, progress reports should include the following:

1) A brief description of the project scope. This should be 1-2 sentences only and serves to remind the reader of the overall objective(s). This blurb will likely remain unchanged for the entire semester; *i.e.*, used in all progress reports.
2) The main contents of the progress report should detail specifically what was accomplished during the previous three weeks. This may include calculations, a description of designed components and an accompanying sketch – any useful information that will help the staff assess your progress. If data were acquired, a plot of the results should be presented and discussed. If any issues or problems were encountered, they should be addressed (what happened, plans for mitigation and effect on the timeline).
3) A concise explanation of the tasks to be performed during the upcoming weeks.
4) Each progress report should include an up-to-date timeline (Gantt chart).
5) Progress reports should be approximately one page of text excluding the brief description, any figures and the Gantt chart.
6) For each Progress Report, each group member is also required to submit a Group Evaluation Form.

Appendix C: Suggested Format for Final Report

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 25 pages of typed double spaced text, including appendices.

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 experiment 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. (**Detailed uncertainty analysis could be placed into an Appendix and should definitely be in your lab notebook, but do not clutter the main body of your final report with lengthy uncertainty derivations.**) Also, do not go into a narration of all the trouble you went through to get to your final set-up!

Results and Discussion can be two separate sections or one. 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 so as 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 D

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<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 E

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Group Evaluation Form

Although all Progress Reports and the Final Report are turned in as a group, each student is required to submit the following Group Evaluation Form with each of these assignments. Turn this form in on the same day **in RRB 101**. There will be a separate drop box for the Group Evaluation Forms.

Use this form to evaluate the contributions made to your AME 441 Senior Project by **all members** of your group (**including yourself**) during the given period. In the table provided below, print the names of all group members and assign a score for each performance category. Rank each category on a scale of 0 to 4 (0 being the lowest; 4 being the highest); don't forget to rate *your* performance as well. You should provide specific comments for each team member in the space provided. The scoring guideline is as follows:

0 = Poor, would have been better without

1 = Below average, rarely met expectations

2 = Average, fulfilled expectations of the group

3 = Above average, occasionally exceeded expectations

4 = Outstanding! Often exceeded expectations

Group #	**Project Title:**				
Team Member NAME	**Cooperation**	**Dependability**	**Participation**	**Quality of Work**	**Interest and Enthusiasm**
your name					
	Comments:				
	Comments:				
	Comments:				
	Comments:				

Appendix F: Faculty List – AME Department

Name	Area of Interest	Office	Email
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 203	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. V. Eliasson	Shock wave behavior in gases and liquids, shock wave focusing, shock wave-solid interactions	RRB 220	eliasson@usc.edu
Prof. A. Fincham	Experimental fluid mechanics, environmental and geophysical fluid mechanics, turbulence and waves, optical diagnostics		afincham@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	KAP 254	ghanem@usc.edu
Prof. A. Hodge	Metallic materials, nanomechanics, nanocrystalline materials processing, high temperature mechanics, thin and thick film coatings, biomaterials mechanics, foam processing	RTH 503	ahodge@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. Kassner	Metal plasticity theory, creep, fracture, phase diagrams, fatigue, and semi-solid forming	OHE 400C	kassner@usc.edu
Prof. T. Langdon	Mechanical properties of metals and ceramics, creep, superplasticity, processing and properties of ultrafine-grained materials, severe plastic deformation	OHE 430G	langdon@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. L. Redekopp	Theoretical fluid mechanics, nonlinear waves and stability, geophysical fluid dynamics	RRB212	lg.redekopp@usc.edu
Prof. P. Ronney	Combustion, micro-scale power generation and propulsion, biophysics and biofilms, turbulence, low-gravity phenomena, internal combustion engines and control systems,, radiative transfer	OHE 430J	ronney@usc.edu
Prof. S. Sadhal	Drops and bubbles in acoustic fields,heat conduction in composite solids thermo-capillary flows with drops in low gravity	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. F. Udwadia	Dynamics and control, mechanics and mathematics, collaborative engineering, engineering management, structural dynamics, system identification	OHE 430K	fudwadia@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

Appendix G: Faculty List – ASTE Department

Name	Area of Interest	Office	Email
Daniel Erwin	Spacecraft propulsion, optics and optical instruments, kinetics of gases and plasmas	RRB 222	erwin@usc.edu
Sergey Gimelshein	Computational fluid dynamics and hypersonic aerodynamics, spacecraft propulsion, laminar separated flows, plume flows, plume interactions and surface contamination, physics of molecular energy transfer, upper atmosphere radiation processes, chemical reactions in gas phase and on the surface.	RRB 201	gimelsch@usc.edu
Mike Gruntman	Spacecraft and space mission design, propulsion, space physics, space sensors and instrumentation, space plasmas.	RRB 224	mikeg@usc.edu
Darrell Judge	space science, spectroscopy, deep space and sounding rocket flight experiments	SHS 270	djudge@lism.usc.edu
Michael Kezirian	System Safety, Propulsion, Spacecraft Dynamics and Fuel Slosh, Composite Overwrapped Pressure Vessel Design and Analysis.		kezerian@usc.edu
Joseph Kunc	Nonlinear models of nonequilibrium plasmas, molecular dynamics, transport of particles and radiation in high-temperature gases, atomic and molecular interactions, statistical thermodynamic	RRB 230	kunc@usc.edu
Phillip Muntz	Hypersonics, gas kinetics and plasmas, high performance materials, micromechanical devices, space science	RRB 101	muntz@usc.edu
Herbert Schorr	Artificial intelligence, advanced computing systems, information technology		schorr@isi.edu
F. Stan Settles	Engineering management, integrated management and design, quality management, manufacturing for biomedical/biotechnical applications	GER 2126C	settles@usc.edu
Joseph Wang	Electric propulsion, space environment and spacecraft interactions, particle simulation algorithms for gases and plasmas, microfluidics	RRB 216	josephjw@usc.edu