# USC Viterbi School of Engineering

## AME 341aL Mechoptronics Laboratory

**Units: 3**

**Term: Fall 2018** **M Aug 20nd – F Nov 30th**

**Location:** Lecture MWF 8am SGM 124/SGM 101
Lab M, T, W or Th 2-5pm BHE 301
See course Blackboard page
http://software.usc.edu/ (install Matlab)


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| **Instructors:** | Dr. Matthew Gilpin | Dr. Bo Cheng Jin |
| **Office:** | PHE 314 | TBD |
| **Office Hours:** | TBD | TBD |
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| **Teaching Assistants:** | Aneesh Bhattacharyya | Haowen Liu | Sichen Yuan |
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| **Office:** | | **BHE 301** | |
| **Office Hours:** | | **See Blackboard** | |


### Course Description

A coordinated laboratory and lecture sequence on aeromechanical instrumentation and device control stressing the symbolic integration of mechanical, optical and electronic components. This course is intended for junior level aerospace and mechanical engineering students, and is designed to develop self-sufficient, capable, and critically thinking engineers.

### Learning Objectives

AME 341aL teaches the basics of aerospace and mechanical experimentation; this includes how to make a measurement, perform analysis, and report on technical findings. Laboratory experiments introduce the students to a variety of digital and analog measurement devices and often require the construction of basic circuits; the physical principles of these devices are presented during the lecture section, and the capabilities and limitations are explored during the laboratory section. Assignments focus on clarity in technical communication both written and graphic. Diligent data collection followed by detailed data analysis is required and both Matlab and MS-Excel computational methods and data presentation are employed. Lab results are communicated in a written technical format of publishable quality.

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| **Prerequisite(s):** | MATH 126, PHYS 152 |
| **Co-Requisite (s):** | n/a |
| **Concurrent Enrollment:** | n/a |
| **Recommended Preparation**: | n/a |

### Course Notes

AME 341aL relies heavily on the USC Blackboard and Piazza for all course communications. This includes discussion forums for assignments, course documents, and grade reporting. Before the semester begins, students should verify they have access to all web content.

### Technological Proficiency and Hardware/Software Required

**Matlab**: student license available at http://software.usc.edu/

**MS-Excel**: student license available at https://itservices.usc.edu/officestudents/

Access to both programs is required. These programs are also installed in all USC computer labs as well as in the Mechoptronics Lab (BHE 301).

| | Date | Lecture | Lab Contents | Assignment Due | % |
|---|---|---|---|---|---|
| 1 | M 8/20 | (0) The Basic Ideas | (0) Introduction to Lab; Hello {graphical} world | | |
| | W 8/22 | (1) Error Analysis I | | | |
| 2 | M 8/27 | (2) Error Analysis II | (1) Physical Measurements | **A0 Due** | **3** |
| | W 8/29 | (3) Error Analysis III | | | |
| 3 | M 9/3 | **Labor Day** | | **A1 Due** | **7** |
| | W 9/5 | (4) Elements of Electronics | | | |
| | F 9/7 | (5) A1 Recap | | | |
| 4 | M 9/10 | (6) Linear Circuits I | (2) Real and Virtual Instruments | | |
| | W 9/12 | (7) Linear Circuits II | | | |
| | F 9/14 | (8) Linear Circuits III | | | |
| 5 | M 9/17 | (9) 1st Order Systems I - Phasors and Complex Exponentials | (3) Linear Circuits | **A2 Due** | **7** |
| | W 9/19 | (10) 1st Order Systems II - Principles | | | |
| | F 9/21 | (11) A2 Recap | | | |
| 6 | M 9/24 | (12) 1st Order Systems III - Practical examples | (3.5) Excel & the Engineer | | |
| | W 9/26 | (13) Op Amps I - Steady State | | | |
| 7 | M 10/1 | (14) Op Amps II - Frequency Response | (4) Transfer Function of a 1st Order System | **A3.5 Due** | **4** |
| | W 10/3 | (15) How to Write a Report | | | |
| | F 10/5 | (16) A3.5 Recap | | | |
| 8 | M 10/8 | (17) Omp Amps III | (5) Properties of Op-Amps | **A4 Due** | **10** |
| | W 10/10 | (18) Digital Circuits I - How to Build a Computer | | | |
| | F 10/12 | (19) A4 Recap | | | |
| 9 | M 10/15 | (20) Digital Circuits II - Analog-Digital Converters | **(LP) Lab Practical** | | **10** |
| | W 10/17 | (21) Digital Circuits III - Analysis of Discrete Signals | | | |
| | F 10/19 | (22) Digital Signal Processing - I | | | |
| 10 | M 10/22 | (23) LP Results | (6) Digital Circuits | **A5 Due (Report #1)** | **14** |
| | W 10/24 | (24) What have we done? Quiz Preview | | | |
| | F 10/26 | (25) A5 Recap | | | |
| 11 | M 10/29 | (26) Digital Signal Processing - II | (7) Analysis of Discrete Time Series | **Exam!** | **15** |
| | **W 10/31** | **(27) "Two Thirds Term" Exam!** | | | |
| | F 11/2 | (28) TQ post mortem | | | |
| 12 | M 11/5 | (29) Acoustics I - The wave equation | | **A7 Due** | **9** |
| | W 11/7 | (30) Acoustics II - Plane waves | | | |
| | F 11/9 | (31) A7 Recap | **Last day to drop with a mark of W** | | |
| 13 | M 11/12 | (32) Acoustics III - Production & measurement of pressure waves | (8) Making Noise - Acoustic Waves | | |
| | W 11/14 | (33) How to Write a Report II | | | |
| 14 | M 11/19 | No Lecture | NO LAB | | |
| | W 11/21 | **Be Thankful** | | | |
| 15 | M 11/26 | (34) Something fascinating | NO LAB | **A8 Due (Report #2)** | **16** |
| | W 11/28 | (35) Course Summary/Results | | | |

## Required and Supplementary Materials

There are no "Required" text textbooks for AME 341aL. A course reader will be provided which includes background information related to the topics discussed during lecture and lab. The course reader supplements the topics covered in class; thus, by definition, it is not as detailed as the material presented during lecture and lab. There are several *optional* textbooks outlined below, but note there are several copies available for reading in BHE 301 (these copies are to remain in the lab):

(optional) Introduction to Mechatronics and Measurement Systems, Alciatore & Histand (2011) McGraw-Hill.
(optional) Theory and Design for Mechanical Measurements, Figliola & Beasley (2010) Wiley.
(optional) The Art of Electronics, Horowitz & Hill (1989) Cambridge University Press.

## Description and Assessment of Assignments

There will be one written exam (W Oct. 31st) and one lab practical exam (week of Oct. 15th, conducted during your regularly scheduled lab time). The remainder of the course assignments will be based on experiments conducted in lab. All assignments are typically due within one week, unless otherwise noted. All assignments will be produced using a technical report writing style, which will be detailed during lecture. Data analysis will be performed using both Matlab and MS-Excel. For some assignments you can choose which software to use; however, several assignments require specifically Matlab or specifically Excel, as detailed in the lab handbook.

## Grading Breakdown

Subject to change; see Course Schedule

| Assignment | % of Grade |
|---|---|
| A0 | 3 |
| A1 | 7 |
| A2 | 7 |
| A3.5 | 4 |
| A4 | 10 |
| LP | 10 |
| A5 | 14 |
| TQ | 15 |
| A7 | 9 |
| A8 | 16 |
| Lab Performance | 5 |
| **Total** | **100** |

## Assignment Submission Policy

Each assignment is due **before** lab begins, as specified at lab time or in class announcements. Physical documents must be handed in at the lab in BHE 301. They must be handed in on time. **A late assignment will be docked 50% and no assignment will be accepted after 8am on the day following the due date. One microsecond ($1\ \mu s$) late is considered late and there are no exceptions.** For similar reasons, there are no make-up labs. All labs and assignments will count towards the total grade (*i.e.*, none are dropped). Absences for medical reasons must be justified with some reasonable evidence. It is not possible to pass the course if you are missing two or more assignments or any labs.

## Additional Policies

See the Mechoptronics course reader for all policies, codes of conduct, and expectations. Read that in full.

## Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* https://scampus.usc.edu/b/11-00-behavior-violating-university-standards-and-appropriate-sanctions/. **All forms of academic dishonesty are unacceptable.** See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

## Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://dsp.usc.edu/ provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* http://emergency.usc.edu will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.