

# AME 261 – Basic Flight Mechanics

Spring 2016

**Instructor** Charles Radovich [radovich@usc.edu](mailto:radovich@usc.edu) RRB 202 Office Hours: MW 12 – 2p and by appt.

**Lecture** T Th 10 – 11:50 am, ZHS 163

**Discussion** Friday 2 – 2:50 pm, ZHS 163

**Textbook** Anderson Jr., John D. Introduction to Flight.  
McGraw-Hill. 7<sup>th</sup> edition



Homework & Quizzes	20%
Group Design Project	15%
Two Midterm Exams	30% (15% each, drop lowest of three exams)
Final Exam	35%

## Reading Assignments

1	Jan 12-14	Intro/Atmosphere/Continuity and Bernoulli equations	Ch. 3 – 4.5
2	Jan 19-21	Energy equation, viscosity, wings, Mach number and $C_p$	Ch. 4.6-9, 4.15-21 & 5.1-7
3	Jan 26-28	Induced drag, aircraft drag, propulsion	Ch. 5.12-24 & 9.1-6
4	Feb 2-4	$E_{max}$ , $V_{Dmin}$ and power requirements	Ch. 6.1-6 & 6.25
5	Feb 9-11	Altitude effects, climbing flight, ceiling and gliding flight	Ch. 6.7-10 & notes
6	Feb 16-18	Compressibility, Mach effects, wave drag and swept wing <b>Exam #1 on Feb 18</b>	Ch. 5.7-12, 5.16 & notes
7	Feb 23-25	Range, optimum cruise altitude and endurance	Ch. 6.11-14 & notes
8	Mar 1-3	Cruise at different altitudes, speeds and angles of attack	Ch. 6.11-14 & notes
9	Mar 8-10	Takeoff performance	Ch. 6.15 & 5.17
10	Mar 15-17	<i>Spring Break</i> (March Madness)	
11	Mar 22-24	Landing Performance <b>Exam #2 on Mar 24</b>	Ch. 6.15-16
12	Mar 29-31	Turning performance and energy methods	Ch. 6.17-23 & notes
13	Apr 5-7	Aircraft moments, stability criteria and partial derivatives	Ch. 7.1-6
14	Apr 12-14	Longitudinal static stability, effects of wings, tail and canards <b>Exam #3 on Apr 14</b>	Ch. 7.7-12
15	Apr 19-21	Trim, stick free stability and lateral stability	Ch. 7.13-21 & notes
16	Apr 26-28	Misc. and review	

The **Final Exam** will be on Tuesday May 10<sup>th</sup> at 11 am – 1 pm

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ISBN-10: 0073380245; ISBN-13: 9780073380247. (6<sup>th</sup> and paperback (intl.) editions also ok)

### Course Description

#### **AME-261 Basic Flight Mechanics**

Units: **4**      *Recommended preparation:* AME-105, AME-150L, AME-201 and PHYS-151

Performance of flight vehicles; maximum speed, rate-of-climb, range, and endurance; basic stability and control, weight and balance; computer exercises. *(from the USC Course Catalogue)*

**Homework** will be assigned every week and will be due one week (*i.e.*, 7 days) after it is assigned. Approximately half of the homework will involve the use of a computer and will require graphical results. All students should be familiar with the university computer labs; alternatively, a personal computer can be used to solve the assignments. Homework will not be accepted late for unexcused reasons. A down computer is not a reason for late homework. Under no condition should you attempt to complete your assignment the night before it is due because most problem sets require more than one evening's work.

In order to receive credit for your work, all homework, quiz and exam problems must be presented in a clear, organized manner. Solutions must show evidence of work; "magic" answers will not be accepted. Partial credit may be given if the solution is presented in a logical fashion.

Students may work together on the homework by helping each other to discuss the problems, review the lectures, set up the problems, etc. **However, when you sit down to write a computer program or solve the homework problems, each student must do that individually.** You may also discuss each other's computer programs but under no circumstances should you copy anyone's work. Do not share or email anything; this goes for all courses at USC. **Failure to comply with this requirement will result in an F for the course.** All students should read and understand the USC Student Code of Conduct outlined in the Academic Dishonesty Guidelines [http://www.usc.edu/student-affairs/SJACS/forms/sjacs\\_appa.pdf](http://www.usc.edu/student-affairs/SJACS/forms/sjacs_appa.pdf).

A group **Design Project** will be initiated after the first midterm. Groups of students will be required to design several aspects of an aircraft within given constraints. Details will be discussed further during class.

There will be **three Midterm Exams** in the course as noted in the syllabus. Please note the exam dates on your calendar now so that you will not miss any of them. All exams will be closed notes unless stated otherwise.

The **Final Exam** will be given on Tuesday, May 12<sup>th</sup> from 11:00 am to 1:00 pm.

**Calculators:** Standard scientific calculators are allowed for use during all quizzes, midterms and the final exams. Programmable calculators and wireless devices (*e.g.*, cell phone, iPod/Pad, etc.) are not permitted.

**Final grades** will be computed as follows:

Homework & Quizzes	20%
Group Design Project	15%
Two Midterm Exams	30% (15% each, drop lowest of three exams)
Final Exam	35%

## HOMEWORK SOLUTIONS

### IMPORTANT RULES AND TIPS

Technical communication is an extremely important skill required of all engineers. If you cannot present your work well to your boss or co-workers, do not expect a raise. Likewise, if you cannot present your technical work well in this class, you will not get a good grade on your assignments. Thus, all homework **must** be presented in a professional manner. Follow the guidelines below:

1. A hard copy of your work must be submitted in order to receive credit; scanned/faxed/emailed submissions will not be accepted. Print your name on each page of your homework and staple all pages together.
2. Homework is to be done on 8.5" x 11" paper **only**. Write on only one side of each page and be sure that mistakes are clearly erased or carefully crossed out so that anyone can read and follow your work without difficulty. If the grader cannot follow your logic or your work is messy, the homework will be returned to you ungraded and a score of zero recorded.
3. It is necessary that you present your work neatly, logically and professionally. To receive full credit on homework and exam problems **all** of the following **must** be shown:
  - a) Write down all given **data** at the beginning of the problem solution.
  - b) Include a **free hand sketch** of the problem whenever possible.
  - c) State the **assumptions** used in the problem.
  - d) Write the equations to be used in **symbolic form**. Indicate where you obtained the equations and verify that the assumptions embedded within the equations are consistent with the problem you are attempting to solve. Manipulate the equations in **symbolic form** to obtain the desired form **before** substituting in the numerical values (see example problems 4.3 and 4.4 in your book). **No exceptions!**
  - e) **Algebraic steps** are an important part of your work and should be shown. Again, no exceptions.
  - f) Work through the **Units** in your calculations and show conversion of the units as needed. Be sure to give BOTH THE NUMERICAL VALUE AND THE UNITS in your answer. Why? Because  $4 \neq 4 \text{ m/s}$ .
  - g) Round off the final numbers and report only **Significant Digits** consistent with the accuracy of the data (*i.e.*, if the data are given to 3 significant digits, DO NOT present an answer with 8 significant digits). If some of the data have only one digit given, *e.g.* angle of attack  $\alpha = 8$  degrees, you should assume that two digits are implied (*i.e.*,  $\alpha = 8.0^\circ$ ). In this case, your answer should contain only two significant digits although three significant digits will be accepted. Generally, you should have three significant digits in your answer unless you can justify more or less based upon the given data.
4. Remember that the most important aspect of homework and exam solutions (typically 80-90% of the grade for the problem) is **the method** and not the correct answer. Thus, indicate how the solution was obtained by showing each step in the solution and where the data were acquired.
5. Place a box around your answer to clearly indicate your final answer.

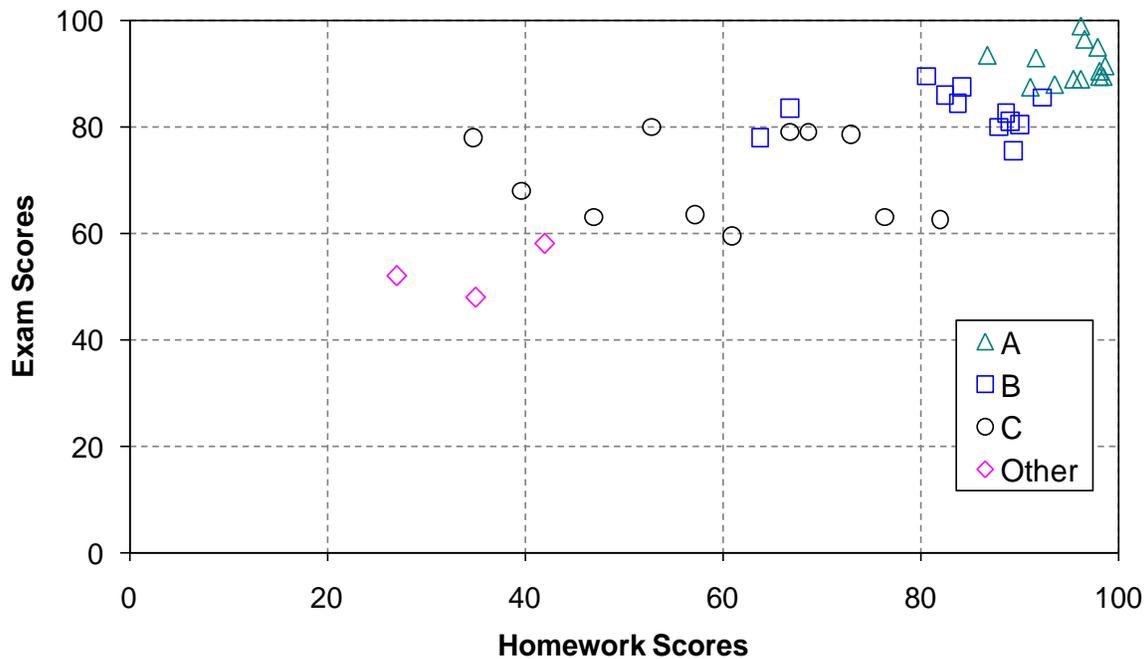


Figure 1. Correlation between Homework and Exam scores

Figure 1 is provided above to show the relationship between the homework scores (normalized to 100 points) and the grades on the exams (colored by the final grades given in the course). This data is from a previous semester, but the trend is consistent year after year. Several items are very striking. First, there is a strong correlation between how well students do on their homework and how well they do on their exams; do not think that the homework is inconsequential. If you are having trouble with your homework, seek some help either by seeing the instructor, the teaching assistant or get additional tutoring (Viterbi Academic Resource Center). Secondly, data over the past several year's shows that about one third of the students in the class earn an A, one third earn a B and the remaining third earn a C or lower. Lastly, looking at the individual homework scores (not shown), the lower scores were primarily due to students not submitting several of their assignments; it was not because they did poorly on all of their assignments. **Hence, be sure that you complete, understand the concepts within and turn in ALL of your homework if you want an A or B in the course.**

**Tutoring** is available for this course through the Viterbi Academic Resource Center (<http://viterbi.usc.edu/VARC/>).

The Department of Aerospace & Mechanical Engineering adheres to the University's policies and procedures governing **Academic Integrity** as described in the *USC Catalogue*. All engineering faculty, staff and students share the responsibility for maintaining an environment of integrity. Students are expected to be aware of and observe the academic integrity standards described in the *USC Catalogue* and you should expect those standards to be enforced in AME-261. In case you missed it earlier in this document, read this: [http://www.usc.edu/student-affairs/SJACS/forms/sjacs\\_appa.pdf](http://www.usc.edu/student-affairs/SJACS/forms/sjacs_appa.pdf).



## Statement on Academic Conduct and Support Systems

### 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. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* <https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions>. Other forms of academic dishonesty are equally 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://sait.usc.edu/academicsupport/centerprograms/dsp/home\\_index.html](http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html) 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.