# AE 6355: Planetary Entry, Descent and Landing

**Textbooks:** Recommended: Regan & Anandakrishnan, *Dynamics of Atmospheric Re-Entry,* AIAA Education Series, 1993.
Recommended: Braun, *Planetary Entry, Descent and Landing*, Shortcourse Notes, Aug 07.
Reference: Vinh, Busemann and Culp, *Hypersonic and Planetary Entry Flight Mechanics*, 2nd edition, University of Michigan Press, 1980.
Reference: Anderson, John D., *Hypersonic and High Temperature Gas Dynamics*, McGraw-Hill Book Company, 1989.

## Course Overview:

AE6355 is a graduate-level elective that provides an integrated overview of planetary entry systems. The course content includes vehicle systems and definition, entry flight mechanics and dynamics, aerothermodynamics and thermal protection systems, aerodynamic decelerators and landing systems, and case studies based on recent robotic and human exploration mission concepts. Chapters 1-4, 6 and 9 of the text will be assigned.

Four homework sets will be assigned. Homework assignments will include a modest degree of computer programming. An individual computer project will be assigned. This project requires development of an analysis tool capable of assessing at least one of the disciplines of importance in planetary entry applications (e.g., aerodynamics, heating, trajectory, etc.). Verification of the analysis tool must be made with existing flight data. A final report of 15 pages or less, not including an appendix for the source code, is required. This report must be written in a professional manner, documenting the project scope, significance, analysis approach, results and verification.

There will be one in-class midterm and a comprehensive final exam. All tests employ a closed book, closed notes format. Class lectures will be videotaped and broadcast for distance learning students at the National Institute of Aerospace.

## Lecture Topics:

The following is the draft set of lecture topics. Content adjustments are expected during the semester based on schedule progress and the availability of guest lecturers.

| | |
|---|---|
| Aeroassist mission classes and definitions | 3 hours |
| Hypersonic aerodynamics | 6 hours |
| Atmosphere and gravity models | 3 hours |
| Ballistic entry flight mechanics | 3 hours |
| Lifting entry flight mechanics | 3 hours |
| Bank angle modulation and atmospheric | 3 hours |
| Simulation | 1.5 hours |
| Hypersonic inflatable decelerators | 1.5 hours |
| Aerothermodynamics | 3 hours |
| Thermal protection systems | 3 hours |
| Terminal descent and propulsive descent | 3 hours |
| Parachutes and aerodynamic decelerators | 3 hours |
| Landing systems | 3 hours |
| Flight project case studies | 3 hours |