AAE 590: Hypersonic Performance and Design

Course Syllabus - Spring 2013 - 3 credit hours

Instructor

Dr. Michael Grant, Assistant Professor
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Office: ARMS 3212, Phone: 765-494-4054
Office Hours: MWF 9:30-10:30pm or by appointment

Lectures

MWF 8:30 - 9:20am, ARMS 1021

Course Website

Blackboard Learn Course Management System
http://www.itap.purdue.edu/tlt/blackboard/
Electronic material (*e.g.*, assignments) will be made available on the Blackboard website throughout the semester. Note, Blackboard Vista will **NOT** be used.

Textbook

Recommended: Regan and Anandakrishnan, *Dynamics of Atmospheric Re-Entry*, AIAA Education Series, 1993.
Bryson and Ho, *Applied Optimal Control*, Taylor and Francis Group, 1975.
Elsgolc, *Calculus of Variations*, Dover Publications, 2007.

Additional: Vinh, Busemann, and Culp, *Hypersonic and Planetary Entry Flight Mechanics*, 2nd Edition, University of Michigan Press, 1980.
Anderson, J. D., *Hypersonic and High Temperature Gas Dynamics*, AIAA, 2000.
Vanderplaats, G. N., *Numerical Optimization Techniques for Engineering Design*, Garret N. Vanderplaats, 2005.

Exam Policy

There are two examinations: Evening midterm on **Wed., Feb. 27** (tentative), and Final Exam during scheduled time.

Grades

Midterm: 25%
Final: 25%
Homework: 50%

Learning Objectives

Recognize and distinguish hypersonic flight architectures.
Derive and apply fundamental hypersonic aerodynamic solutions.
Model hypersonic trajectories for various missions.
Comprehend and apply various trajectory optimization techniques and guidance algorithms.
Implement analyses of moderate complexity in computer programs to produce correct engineering results.

Submissions

Please see the "Submission Standards" document on the course website.
Simply following the standards will improve your grade.
No late submissions will be accepted.

Conduct

1) Attendance and active participation is strongly encouraged.
2) Students must adhere to the Purdue Academic Honor Code http://www.purdue.edu/univregs/studentconduct/index.html

Emergency Notice

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Here are ways to get information about changes in this course (all listed above): a) course website, b) instructor email,

instructor phone.

Topics and Dates

The following is a draft set of lecture topics. Content adjustments are expected during the semester based on schedule progress and the availability of potential guest speakers. Expected homework issuance and due dates are noted.

Date	Topic	Homework
01/07	Hypersonic mission classes and definitions	
01/09	Hypersonic mission classes and definitions	
01/11	Hypersonic aerodynamics	
01/14	Hypersonic aerodynamics	
01/16	Hypersonic aerodynamics	
01/18	Hypersonic aerodynamics	HW 1 Assigned
01/21	No class - Martin Luther King Jr. Day	
01/23	Hypersonic aerodynamics	
01/25	Hypersonic aerodynamics	
01/28	Atmosphere and gravity models	
01/30	Atmosphere and gravity models	
02/01	Atmosphere and gravity models	HW 1 Due, HW 2 Assigned
02/04	Atmosphere and gravity models	
02/06	Ballistic entry flight mechanics	
02/08	Ballistic entry flight mechanics	
02/11	Ballistic entry flight mechanics	
02/13	Lifting entry flight mechanics	
02/15	Lifting entry flight mechanics	HW 2 Due, HW 3 Assigned
02/18	Lifting entry flight mechanics	
02/20	Lifting entry flight mechanics	
02/22	Bank angle modulation and entry corridor	
02/25	Simulation	
02/27	**Midterm**	HW 3 Due, HW 4 Assigned
03/01	Simulation	
03/04	Parameter optimization and collocation	
03/06	Parameter optimization and collocation	
03/08	Parameter optimization and collocation	
03/11	No class - Spring vacation	
03/13	No class - Spring vacation	
03/15	No class - Spring vacation	
03/18	Continuous optimal control	
03/20	Continuous optimal control	
03/22	Trajectory optimization using variational methods	HW 4 Due, HW 5 Assigned
03/25	Trajectory optimization using variational methods	
03/27	Trajectory optimization using variational methods	
03/29	Trajectory optimization using variational methods	
04/01	Trajectory optimization using variational methods	
04/03	Trajectory optimization using variational methods	
04/05	Trajectory optimization using variational methods	HW 5 Due, HW 6 Assigned
04/08	Trajectory optimization using variational methods	
04/10	Trajectory optimization using variational methods	
04/12	Guidance algorithms	
04/15	Guidance algorithms	
04/17	Guidance algorithms	
04/19	Pseudospectral methods	HW 6 Due, HW 7 Assigned (due at final)
04/22	Pseudospectral methods	
04/24	Rapid design techniques	
04/26	Rapid design techniques	