

CARLETON UNIVERSITY
Department of Mechanical and Aerospace Engineering

Transatmospheric and Space Propulsion (AERO 4442) – Winter 2015

Lectures: Tuesdays & Thursdays 1:00 - 2:30 pm

Grading

Assignment One	15%	(Due February 12)
Assignment Two	15%	(Due March 19)
Final	70%	(if two assignments are completed)
OR	85%	(if one assignment is completed)
OR	100%	(if no assignments are completed)

Note: The final exam is for evaluation purposes only and will not be returned to the student.

Week **Content**

1	Introduction	-	Impulse, velocity, two body problem
2-3	Orbital missions	-	Conic sections, orbital energy and angular momentum, vis-viva integral, circular orbits, escape velocity, launch velocity, burnout conditions
3-5	Rockets	-	Thrust equation, nozzles (exhaust velocity, massflow, expansion ratio), over/under expansion, spike nozzles, thrust co-efficient
		-	Equivalent velocity, maximum thrust, divergence factor, characteristic velocity
6-8	Combustion	-	Rocket fuel classifications, solid propellants, grain shape (progressive, neutral, regressive burn), surface recession, burn rate
		7	Reading week (Feb. 16-20)
		-	Liquid propellant systems (gas generator, expander, staged combustion), injector design, two phase flow
		-	Equilibrium temperature, Gibbs minimization technique
9-10	Trajectory	-	Single/multi stage, gravity turn, jet damping, ballistic trajectory
10-12	Airbreathing	-	Ramjet/scramjet, supersonic inlets, oblique shocks, combined cycles, Magneto-Hydro-Dynamic concepts
13	Electromagnetic Propulsion (time permitting) and review		

Instructor: J. Etele
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COURSE OBJECTIVE: To contextualize our existing knowledge in terms of its application to placing objects in space
AND
Be capable deriving and analyzing all manner of equations relevant to launch propulsion
AND
To develop both an understanding and appreciation for the possibilities of designing advanced propulsion concepts

- GOALS:**
- 1) To understand why launch and space propulsion engines are designed the way that they are
 - 2) To develop the capacity to discuss and evaluate various existing and potential designs with regard to a desired application
 - 3) To GRADUATE so that we can start paying our parents back (although you know it is impossible to adequately compensate them for their love and support!), move to a warmer climate (like California where you will find a job consulting on the latest Star Trek movie), buy a hybrid car and put racing stripes on it (because you know its both the right thing to do and a tasty way to do it), and retire (because lets face it, you've worked hard enough over the past four years, you've earned it!).

Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see the Student Guide.

Religious obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see the Student Guide.

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the [PMC website](#) for the deadline to request accommodations for the formally-scheduled exam (if applicable).