

**16.522 Space Propulsion
Fall 2018
Lecture Outline**

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Meets TR 9:30-11:00, Room 33-422

Grading:

Problem sets	50%
Laboratory Project	50%

The laboratory project for this year will be to design, build and test a hybrid Hall thruster that can operate as a 'near-vacuum' engine, using the ambient particles from low earth orbit as its propellant, or as a regular Hall thruster, carrying the propellant onboard. The engine will be operated at SPL facilities and will be analyzed using a retarding potential analyzer (RPA) to examine the energy of the ions being produced. Grading of the laboratory will be based on project results, reporting and individual contributions.

Participants will need to go through MIT-EHS safety training before gaining access to the laboratory. In addition, specific training at SPL will be required.

<u>Lec #</u>	<u>Date</u>	<u>Notes</u>	<u>Read RGJ</u>	<u>Lecture Topic</u>
1(PL)	9/6	L1		Introduction
2(PL)	9/11	L2	Ch 1	Fundamentals and definitions
3(PL)	9/13	L3-4	Appendix	Mission analysis I
4(PL)	9/18	L3-4		Mission analysis II
5(CG)	9/20	L10	Ch 2, 5-1	Basic electromagnetic theory and plasma physics
6(CG)	9/25	L11	3-1,3-2	Physics in the plasma sheath
7(CG)	9/27	L12	3-3,3-4, Ch4	Plasmas in equilibrium
8(CG)	10/2	L9	6-3	Electrothermal augmentation
9(CG)	10/4	L13	6-4,6-5,6-6	Arcjet Thrusters
10(CG)	10/11	L14-15	Ch 7	Electrostatic thrusters
11(CG)	10/16	L14-15	Ch 7	Ion engines

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12(CG)	10/18	L18	5-4	Hall thrusters
13(CG)	10/23	L19		Hall thruster efficiency and modeling
14(PL)	10/25	L16		Laboratory techniques: vacuum systems
15(PL)	10/30	L17		Laboratory techniques: thruster characterization
16(CG)	11/1	L20-21	Ch 8	Plasma accelerators
17(CG)	11/6	L20-21	Ch 8	Magnetoplasmadynamic (MPD) Thrusters
18(CG)	11/8	L25		Electrodynamic tethers
19(PL)	11/13	L22		Fundamentals of electrospray propulsion
20(PL)	11/15	L23		Electrosprays in droplet mode
21(PL)	11/20	L24		Electrosprays in the pure ionic regime
22(PL)	11/27	L5		Review of classical Astrodynamics
23(PL)	11/29	L6		Analytical approximations for low thrust maneuvers
24(PL)	12/4	L7		Example of optimization methodologies for low thrust trajectories
25(PL)	12/6			Project Review
26(PL)	12/11			Future trends – open discussion

Lecture reading material will be provided.

Textbook:

- Robert G. Jahn, “Physics of Electric Propulsion”, Dover (2006)

Additional resources:

- Journal of Propulsion and Power
- Journal of Spacecraft and Rockets
- Diverse Journals in Applied and Plasma Physics