Electric Space Propulsion (AE435)  
Syllabus

Pre-Requisite: AE 312 or ME 410, PHYS 212, and ECE 205

Instructor: Dr. Christopher Lyne, email: clyne2@illinois.edu

Class Time: T Th 11-12:20PM, 101 Transportation Building

Office hours: Tuesday 1-2PM – in Talbot Lab 319N, and on ZOOM

Meeting URL: https://illinois.zoom.us/j/7878752607?pwd=UXVQa1hnRWtYYVzM5bDdTYWxWTldRdz09
Meeting ID: 787 875 2607
Password: 444559

Course Assistant: Myles Gong, mylesyg2@illinois.edu

This is a Note-Intensive Class! Much of the material is given only in lecture notes. YOU are responsible for attending class and taking notes. Course notes are posted on CANVAS, both PDF and PPT files. The text is important but only supplementary to the notes!


Helpful References:
Purcell, E.M. and Morin, D.J., Electricity and Magnetism, Cambridge Univ. Press, 2014, Ch. 1-3.

Goals: The goals of this class are to:
1. Cover the basics of electromagnetism, gas kinetic theory, and plasma physics.
2. Familiarize you with existing and proposed electric propulsion devices.
3. Prepare you for industrial or graduate work in EP.

Objectives: By the end of the course you should be able to:
1. Demonstrate a working knowledge of electrostatics, electromagnetics, and charged particle motion.
2. Demonstrate a fundamental understanding of Debye lengths, cross-sections, velocity distributions, and adiabatic invariants.
3. Estimate thrust, specific impulse, and jet power given thruster type and operating conditions.
4. Choose appropriate advanced propulsion devices for a specified mission.
Topics: The course outline is as follows:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Reading</th>
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</thead>
<tbody>
<tr>
<td>15-Jan</td>
<td>Introduction, General Definition of EP. Why EP?</td>
<td>Jahn Ch. 2, Purcell Ch. 1-3, Chen Ch. 1-3, Jahn Ch. 5</td>
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<tr>
<td>22-Jan</td>
<td>Electricity, Magnetism, Charged Particles</td>
<td>Jahn Ch. 2, Purcell Ch. 1-3, Chen Ch. 1-3, Jahn Ch. 5</td>
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<tr>
<td>29-Jan</td>
<td>Electricity, Magnetism, Charged Particles</td>
<td>Jahn Ch. 2, Purcell Ch. 1-3, Chen Ch. 1-3, Jahn Ch. 5</td>
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<td>5-Feb</td>
<td>Kinetic Theory, Ionization of Gases</td>
<td>V&amp;K Ch. 1-2, Jahn Ch. 3-4</td>
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<tr>
<td>12-Feb</td>
<td>Kinetic Theory, Ionization of Gases</td>
<td>V&amp;K Ch. 1-2, Jahn Ch. 3-4</td>
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<td>19-Feb</td>
<td>Kinetic Theory, Ionization of Gases</td>
<td>V&amp;K Ch. 1-2, Jahn Ch. 3-4</td>
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<tr>
<td>26-Feb</td>
<td>Kinetic Theory, Ionization of Gases</td>
<td>V&amp;K Ch. 1-2, Jahn Ch. 3-4</td>
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<td>4-Mar</td>
<td>MIDTERM EXAM</td>
<td>March 5, 2024 In-Class</td>
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<td>11-Mar</td>
<td>SPRING BREAK</td>
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<td>18-Mar</td>
<td>Electrothermal Propulsion</td>
<td>Jahn Ch. 6</td>
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<td>25-Mar</td>
<td>Electrothermal Propulsion</td>
<td>Jahn Ch. 6</td>
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<tr>
<td>1-Apr</td>
<td>Electromagnetic Propulsion</td>
<td>Jahn Ch. 8</td>
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<td>8-Apr</td>
<td>Electromagnetic Propulsion</td>
<td>Jahn Ch. 8</td>
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<tr>
<td>15-Apr</td>
<td>Electrostatic Propulsion - Ion Thruster</td>
<td>Jahn Ch. 7, Goebel Katz Ch. 4 &amp; 5</td>
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<tr>
<td>22-Apr</td>
<td>Electrostatic Propulsion - Hall Thruster</td>
<td>Jahn Ch. 7, Goebel Katz Ch. 7</td>
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<tr>
<td>29-Apr</td>
<td>Electrostatic Propulsion - Electrospray</td>
<td>Notes</td>
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</table>

These dates are subject to change, except for the final exam. Changes will be communicated via email and in class.

Notes:
- There are NO make-up exams. But if you have a conflict, notify me early and ahead of time and we can work something out.
- The final exam is cumulative (it covers everything).
- Homework will be due on Thursday at the beginning of class. No Late Homework accepted.
- Homework is to be turned in through Gradescope. Uploads after 11AM beginning of class will not be accepted.

4 Credit Hour Students:
Some students may have registered for 4 hours of credit for this course. Those students enrolled in this course for 4 hours of credit will complete a substantial extra assignment that will count as part of their homework grade. Details on that assignment will be released within the first two weeks of classes starting.
Communication:
Please check your email daily. I also plan to use CANVAS to post HW, handouts, announcements, etc.
https://canvas.illinois.edu/

Academic Dishonesty: Violations of academic integrity are unacceptable. Review the University of Illinois student code section on Academic Integrity and Procedure for more information.
http://studentcode.illinois.edu/article1_part4_1-402.html

Emergency Response:
Emergency response recommendations are provided by the University of Illinois Police Department. Review those procedures at: http://police.illinois.edu/safe
- http://police.illinois.edu/safe for more information on how to prepare for emergencies, including how to run, hide or fight and building floor plans that can show you safe areas.
- http://emergency.illinois.edu to sign up for Illini-Alert text messages.
- Follow the University of Illinois Police Department on Twitter and Facebook to get regular updates about campus safety

SUMMARY of Important E-Platforms for this Course
- ZOOM - https://zoom.us/ - is always available for all class office hours
- Gradescope - https://www.gradescope.com/ - for downloading and uploading homework and exams, and tracking your grades and performance in the course
- CANVAS - https://canvas.illinois.edu - for announcements and course handouts, and homework and exam solutions
- Media Space – https://mediaspace.illinois.edu/channel/channelid/329302142 - lecture videos