UNIVERSITY OF MARYLAND
DEPARTMENT OF PHYSICS

PHYS 761 **Fall 2019**

TITLE: **PLASMA PHYSICS Part I**

INSTRUCTOR: **T M. Antonsen Jr.**
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Office hours by appointment

TEACHING ASSISTANT: **E. J. Paul**
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Office hours TuTh 9:45-10:45 AM

ROOM: **JMP 2202**

TIME: **TuTh 11:00 AM - 12:15 PM**

COURSE DESCRIPTION: An introduction to the basic concepts and phenomena of plasma physics. Topics include: Vlasov theory, plasma waves, particle orbits, plasma equilibrium, stability, transport, and nonlinear wave interactions. These topics will be discussed as they apply to laboratory, industrial processing and space plasmas, as well as to relativistic beams.

REFERENCES:

Arana Rai Choudhuri, The Physics of Fluids and Plasmas, Cambridge Press 1998.
R. J. Goldston and P. H. Rutherford, Introduction to Plasma Physics, IoP 1995.
NRL Plasma Formulary
https://apps.dtic.mil/dtic/tr/fulltext/u2/a447173.pdf
Richard Fitzpatrick: Introduction to Plasma Physics
http://farside.ph.utexas.edu/teaching/plasma/plasma.html

HOMEWORK: Homework assignments will be given periodically and collected in class

EXAMS: There will be two take home exams

REPORT: Students will make a short report either on their research or on a journal article of their choosing

Homework:	**30%**
Report:	**30%**

Exam 1:	**(Tuesday, Oct. 17)**	**20%**
Exam 2:	**(Thursday, Dec 7)**	**20%**

PHYS 761 COURSE OUTLINE

I. Introduction (2 Lectures)

A. The plasma state - basic parameters
B. Ionization processes (brief)
C. Thermal equilibrium (brief)

II. Vlasov Theory (8 Lectures)

A. Heuristic derivation
B. Properties of solutions
C. Relation to fluid equations
D. Derivation from Liouville Equation
E. Linear electrostatic plasma waves
F. Landau damping
G. Two stream and "bump on tail" instability
H. Particle trapping
    -coherent sources of radiation

III. Strong Magnetic Fields (10 Lectures)

A. Particle Orbits
    -magnetic confinement fusion
    -magnetospheres
B. EM waves in magnetized plasma
    1. Linear
    2. Nonlinear - parametric decay
C. Magneto-Hydrodynamics
    1. Low frequency waves
    2. Plasma confinement
    3. Plasma currents and self-generated magnetic fields
        -dynamo
        -reconnection

IV. Collisions (4 Lectures)

A. Basic collisional scattering
B. Transport coefficients

VI. Non-neutral plasmas (2 lectures)

A. Charged particle beams
B. Cold plasma traps