ENGINEERING

ECE 534: Plasma Physics I
(Cross-listed with NE 515/PHYC 534/ECE 495)
TuTh 4:00-5:15 PM, ME 214
(updated 04/16/18)

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Office Hours: By appointment (more on this in August)

Catalog Description: "Plasma parameters, adiabatic invariants, orbit theory, plasma oscillations, hydromagnetic waves, plasma transport, stability, kinetic theory, nonlinear effects, applications."

Web Enhanced: http://learn.unm.edu (you need to be registered for the course; use your UNM NetID and password to access). We will use this web-enhanced component to manage this course.

Prerequisites: ECE 360 or PHYC 405 or equivalent.

Text: F.F. Chen, *Introduction to Plasma Physics and Controlled Fusion*, Vol. 1, 3rd Ed. (Springer, Heidelberg, Germany, 2016).

There will be a problem set biweekly (on average). Some problems will involve computer solutions and plotting, so you will need access to software with math and plotting functions, such as Matlab, Mathematica, *etc.* There will be a midterm and a final (exams will be open book/notes with calculator allowed). Your final grade will be based on:

Midterm	35%
Final	40%
Problem Sets	25%
Grade	**100%**

Emphasized topics are:

- Fundamental plasma concepts and criteria
- Charged particle motions
- Kinetic, two-fluid, and magnetohydrodynamic (MHD) descriptions of plasmas
- Two fluid treatment of plasmas
- Waves in plasmas (two fluid)
- Single fluid (MHD) description of plasmas
- Diffusion and resistivity
- Equilibrium and stability
- Basic nonlinear effects

ECE 495: Undergraduate students registered for ECE 495 will be given the same homework assignments as students registered for the graduate classes. However, 495 students will be required to solve fewer problems on the midterm and final exams.

Syllabus - Lecture No. and Topics*

	Week #	
1. 08/21	**1**	Class logistics, plasma basics **(Chen Chap. 1)**
2. 08/23		Applications of plasma, history of plasma science **(Supplement)**
3. 08/28	**2**	Velocity distribution function, single particle motion **(Chen Chap. 2)**
4. 08/30		Single particle motion – continued **(Chen Chap. 2)**
5. 09/04	**3**	Single particle motion – continued; adiabatic invariants **(Chen Chap. 2)**
6. 09/06		Single particle motion; adiabatic invariants – continued **(Chen Chap. 2)**
7. 09/11	**4**	Kinetic, two-fluid, and MHD descriptions of plasmas **(Bellan Chap. 2)**
8. 09/13		Kinetic, two-fluid, and MHD descriptions of plasmas – continued **(Bellan Chap. 2)**
9. 09/18	**5**	Kinetic, two-fluid, and MHD descriptions of plasmas – continued **(Bellan Chap. 2)**
10. 09/20		Two-fluid equations and two-fluid drifts **(Chen Chap. 3)**
11. 09/25	**6**	Two-fluid equations and two-fluid drifts – continued **(Chen Chap. 3)**
12. 09/27		Waves in unmagnetized plasmas - two-fluid description **(Chen Chap. 4)**
13. 10/02	**7**	Waves in unmagnetized plasmas - two-fluid description – continued **(Chen Chap. 4)**
14. 10/04		Waves in unmagnetized plasmas - two-fluid description – continued **(Chen Chap. 4)**
15. 10/09	**8**	Waves in unmagnetized/magnetized plasmas – two-fluid description **(Chen Chap. 4)**
10/11		*Fall Break – No Class*
16. 10/16	**9**	Waves in magnetized plasmas – two-fluid description **(Chen Chap. 4)**
17. 10/18		Waves in magnetized plasmas – two-fluid description - continued **(Chen Chap. 4)**
18. 10/23	**10**	Waves in magnetized plasmas – two-fluid description - continued **(Chen Chap. 4)**
19. 10/25		Waves in magnetized plasmas – two-fluid description - continued **(Chen Chap. 4)**
20. 10/30	**11**	**Midterm Exam**
21. 11/01		Diffusion in partially ionized plasmas **(Chen Chap. 5)**
22. 11/06	**12**	Diffusion in partially ionized plasmas – continued **(Chen Chap. 5)**
23. 11/08		Coulomb collisions, diffusion in fully ionized plasmas **(Chen Chap. 5)**
24. 11/13	**13**	Plasma resistivity, derivation of MHD equations **(Chen Chap. 5)**
25. 11/15		MHD equations – continued **(Chen Chap. 5)**
26. 11/20	**14**	MHD equilibrium, diffusion in fully ionized plasmas – continued **(Chen Chap. 5)**
11/22		*Thanksgiving Break*
27. 11/27	**15**	Plasma beta, magnetic field diffusion and reconnection **(Chen Sec. 6.3-6.4)**
28. 11/29		Bohm diffusion, sheaths, Bohm criterion, Child-Langmuir law **(Chen Sec. 5.10, 8.2)**
29. 12/04	**16**	Langmuir probes **(Supplement);** Intro. to plasma instabilities **(Chen Sec. 6.5-6.9)**
30. 12/06		Intro. to plasma instabilities – continued **(Chen Sec. 6.5-6.9)**

Final Exam: To be determined.

* Subject to minor changes. Use this as a guide to read the textbook in advance. I will miss some lectures due to travel. I will be posting lecture material on learn.unm.edu for you to study *in lieu* of the class lecture.