

Introduction to Controlled Fusion
Nuclear Engineering 180
Fall Semester 2009

E. C. MORSE

4.0 units. CCN 64021. Class meets at 3:30 to 5:30 PM Tuesdays and Thursdays, Room 3102 Etcheverry. Laboratory experiments will be performed in 1140 Etcheverry. Final Exam Group 20: Saturday 19 December 2009 1230-330P

Text: *Fusion Research*, Vol. 1, by T. Dolan. Available as complete pdf from course web page.

Additional Texts: *Introduction to Plasma Physics*, by R. Goldston. *NRL Plasma Formulary*, Naval Research Laboratory, available from instructor or as complete pdf from web page: <http://wwwppd.nrl.navy.mil/nrlformulary/>.

Schedule of Lectures, Reading Assignments, and Laboratory Experiments:
(Homework to be announced)

Date	Week	Lecture Topics	Reading
27 August	1	Introduction to Fusion Fusion Reactor Description Fusion Confinement Concepts	Dolan Ch. 1 pp. 01-15 Dolan Ch. 2 pp. 16-30
1 September	2	Breakeven Concepts Fusion Nuclear Reactions	Dolan Ch. 2 pp. 31-47
8 September	3	Cross Sections Reactor Power Balance Lawson Criterion	Dolan Ch. 4 pp 73-99
15 September	4	Plasma Fundamentals Particle Orbits	Goldston Ch. 1 pp.1-19 Goldston Chs. 2,3 pp.21-48
Laboratory: Formation and Generation of Plasma I			
22 September	5	Bremsstrahlung Atomic Physics Synchrotron Radiation	Dolan Ch. 3 pp. 49-72 Goldston Ch. 10 pp.147-164
Laboratory: Formation and Generation of Plasma II			
29 September	6	MHD Equilibrium	Dolan Ch. 8 pp. 168-179

		Introduction to Tokamak	Goldston Ch. 9 pp. 129-143
6 October	7	First Exam MHD Waves MHD Instabilities	Dolan Ch. 8 pp. 179-197
Computational Exercise: MHD Equilibrium in Tokamaks			
13 October	8	Plasma Waves Laser-Plasma Interaction	Goldston Ch. 16 pp. 257-268
Computational Exercise: 1-D Laser Fusion Simulation			
20 October	9	Coulomb Collisions Braginskii Transport	Dolan Ch. 8 pp. 204-215 Goldston Ch. 11 pp. 165-184
27 October	10	Fast Ion Collisions Resistive MHD	Goldston Ch. 14 pp. 229-246 Goldston Ch. 20 pp. 337-361
Computational Exercise: Magnetic Stochasticity in Plasma			
3 November	11	Helicity and Taylor States Second Exam	Notes
10 November	12	ICF Target Physics Heavy Ion Fusion Nonlinear Plasma Physics	
Laboratory: Fusion Neutronics I			
17 November	13	Plasma Heating Ion Beam Technology	Dolan Ch. 9 pp. 217-235
24 November	14	Fusion Technology Thanksgiving Holiday	
Laboratory: Fusion Neutronics II			
1 December	15	Superconducting Magnets Lasers Alternate Magnetic Concepts	Notes
8 December	16	Course Review	Notes

General Information Regarding Course:

1. Homework is due one week after it is assigned. It has a prorated grade based upon timeliness, and has no value one week after the due date (i. e. after solution set is available).
2. The course NE 120 should be taken concurrently for those wishing to take NE 280 in the spring. Undergraduates may take course 280 if they have completed other

undergraduate requirements and have an A average in 180.

3. Seniors should consider application for the MFE Fusion Technology or Fusion Science Fellowship programs if they plan to continue their studies of fusion in graduate school.