COURSE OUTLINE

Physics 777

Plasma Physics and Magnetohydrodynamics

Credits: 3

Catalog Description: An introduction to plasma physics and magnetohydrodynamics for advanced graduate students. Applications to Solar Physics are emphasized. Topics include: Plasma parameters; single particle problems; Basic MHD equations; Magpetohydrostatics; Waves; Instabilities; Applications to Solar Physics and Optical Sciences.

Instructors: Haimin Wang

Text Books:

Priest, E.R. Solar Magnetohydrodynamics, D. Reidel Publishing Company, 1984, Dordrecht, Holland

Frances F. Chen
Introduction to Plasma Physics
1984, Plenum, New York

Week 1: Review of Solar Physics
Priest Chapter 1

Week 2: Introduction
Chen Chapters 1, 2 and 7
--Plasma Parameters
--Single Particle Motions
--Introduction to Kinetic Theory

Week 3: Basic Equation of Magnetohydrodynamics
Priest Chapter 2
--Electromagnetic Equations
--Plasma Equations
--Energy Equations
--Lorentz Force
--Fluxtubes and Current Sheets

Week 4: Magnetohydrostatics
Priest Chapter 3
--Current-Free Fields
--Force-Free Fields
--Magnetohydrostatic Fields

Week 5: Waves
Priest Chapters 4 and 5
- -Sound Waves
--Alfven Waves
--Gravity Waves
--Magneto-acoustic
--Acoustic Gravity
--Shock Waves

Week 6: Instability
Priest Chapter 7
--Rayleigh-Taylor Instability
--Kink Instability
--Interchange Instability
--Flow Instability
--Resistive Instability
--Convective Instability
--Other Instability

Week 7: Heating of Solar Upper Atmosphere
Priest Chapter 6
--Acoustic Wave Heating
--Magnetic Heating
--Coronal Loops

Week 8: Sunspots
Priest Chapter 8
--Magnetoconvection
--Magnetic Buoyancy
--Magnetohydrostatic Equilibrium of Sunspots
--Intense Magnetic Fields Instability

Week 9: Dynamo Theory
Priest Chapter 9
--Cowling's Theorem
--Toroidal and Poloidal Fields
--Kinematic Dynamos
--Alpha-Omega Dynamo

Week 10: Solar Flares
Priest Chapter 10
--Magnetic Reconnection
--Simple Loop Flare
--Two Ribbon Flare

Week 11: Prominences and Filaments
Priest Chapter 11
--Formation
--Magnetohydrostatic of Support in a Simple Arcade
--Helical Fields
--Coronal Transients
--Filament Eruptions and Coronal Mass Ejections

Week 12: Solar Wind
Priest Chapter 12
--Parker's Solar Wind Solution
--Models for a Spherical Expansion
--Streamers and Coronal Holes

Weeks 13 and 14: Advanced Plasma Physics and Radio Emission
Guest Lecture (Dr. J. Lee)
This could be inserted in between