University of Wisconsin - Madison
College of Engineering [EGR]
Last Offered: 2015-2016 Spring [1164]
Direct Link to this Syllabus :

1. **E C E 527, Plasma Confinement and Heating**
2. **Credits :** 3  **Contact Hours :** 2.5
3. **Textbook and Materials :** ECE/Physics/EP 527 Course Notes, Anderson, D.

a. **Other Supplemental Materials :** Papers and excerpts from selected texts posted on class webpage.

- **Specific Course Information :**

  a. **Brief description of the content of the course (Course Catalog Description) :** Principles of magnetic confinement and heating of plasmas for controlled thermonuclear fusion: magnetic field structures, single particle orbits, equilibrium, stability, collisions, transport, heating, modeling and diagnostics. Discussion of current leading confinement concepts: tokamaks, tandem mirrors, stellarators, reversed field pinches, etc.

  b. **Pre-requisites or Co-requisites :** NEEP/Phys/ECE 525 or equiv

  c. **This is a Selected Elective course.**

- **Specific Goals for the Course :**

  a. **Course Outcomes :**

    1. Students should be able to calculate particle drifts in the guiding center approximation for various magnetic field structures.
    2. Students should be able to evaluate thermal and particle diffusivity in toroidal systems in different collisionality regimes.
    3. Students should understand the basic concepts of plasma equilibrium and stability between kinetic and magnetic pressures.
    4. Students should be able to calculate temperature relaxation times between species.
5. Students should be able to calculate plasma heating from various sources such as neutral particle beams, ohmic currents, and radio frequency waves.
6. Students should have a good grasp of diagnostics systems which are available to measure plasma properties.
7. Students should be able to perform a rudimentary design of a magnetic confinement systems such as a tokamak.

- **ABET Student Learning Outcomes**:
  (a) Ability to apply mathematics, science and engineering principles.
  (k) Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

- **Brief List of Topics to be Covered**:
  1. Magnetic Confinement Fusion
  2. Magnetic Field Structures
  3. Single Particle Orbits
  4. Neoclassical Transport
  5. Equilibrium
  6. Macroscopic Stability
  7. Coulomb Collision Effects
  8. Microinstabilities
  9. Neutral Beam and RF Heating
  10. Plasma Modeling
  11. Diagnostics
  12. Toroidal Magnetic Fusion Confinement Concepts (tokamaks, stellarators, reversed field pinches)