Georgia Institute of Technology

The George W. Woodruff School of Mechanical Engineering
Nuclear & Radiological Engineering/Medical Physics Program

Ph.D. Qualifier Exam

Spring Semester 2009

_____ Your ID Code

Fusion (Day 3)

Instructions

1. Use a separate page for each answer sheet (no front to back answers).
2. The question number should be shown on each answer sheet.
3. ANSWER 4 OF 6 QUESTIONS ONLY.
4. Staple your question sheet to your answer sheets and turn in.

NRE/MP Fusion

Answer 4 of the following question.

1. Describe the physics of plasma (charged particle) confinement in a tokamak. Describe the drift motions (including magnitudes) and explain why they do not cause a rapid loss of particles?
2. Discuss plasma heating in a tokamak. Can a plasma be resistively (ohmic) heated to fusion temperatures? Describe the physics of electromagnetic wave heating and give the most likely frequencies at which electromagnetic waves launched into a plasma might heat it.
3. Describe how a D-T fusion reactor could produce enough tritium to be self-sufficient in replenishing its fuel supply. What materials might be used to produce tritium?
4. Discuss impurity ions in a fusion plasma. How do they get into the plasma and what effects do they have on plasma performance? How would you estimate the maximum tolerable impurity concentration in a tokamak plasma? How would you prevent or inhibit impurities from entering the plasma? Discuss the pros and cons of using carbon, steel and tungsten as the material of the first-wall of the plasma chamber.
5. Discuss the radial transport of particles and energy in a tokamak plasma. What are the physical mechanisms that cause radial transport? What are the equations that govern particle and energy radial transport?
6. Discuss MHD stability limits in tokamaks. What physical instabilities limit the performance of tokamaks? How does the requirement to achieve MHD stability affect the choice of design parameters for a tokamak?