**Georgia Institute of Technology**

The George W. Woodruff School of Mechanical Engineering

Nuclear & Radiological Engineering/Medical Physics Program

Ph.D. Qualifier Exam

Fall Semester 2015

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 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 any 4 of the following 6 questions**.

**Question 1.**

Describe the function of each of the three different magnet systems in a tokamak. What would be the consequences of removing each magnet system separately?

**Question 2.**

Describe the drifts that take place in a tokamak and give typical values of drift velocities. Why are drifts of interest/concern?

**Question 3.**

Discuss heating of plasmas to fusion temperature regimes. What are the major methods being developed, and what physics are they based on? What plasma temperatures have been achieved in tokamaks, and what levels of plasma heating power are needed for ITER?

**Question 4.**

A circular tokamak with major radius R = 6m, minor plasma radius a = 1.5m, toroidal field at the center of Bφ = 5T and plasma current I = 5 MA has been proposed. Will this tokamak be stable to MHD instabilities?

**Question 5.**

If the central solenoidal magnet of the tokamak in problem 4 has a radius rv = 1.0m, what value of the ohmic heating magnetic field BOH  is needed to induce the plasma current?

**Question 6.**

Discuss Edge Localized Modes (ELMs) in tokamaks. What are they and why are they harmful, what physics causes them, and how can they be suppressed?