**Georgia Institute of Technology**

The George W. Woodruff School of Mechanical Engineering

Nuclear & Radiological Engineering/Medical Physics Program

Ph.D. Qualifier Exam

Fall Semester 2017

\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Your ID Code

**NRE Fusion**

**(Day 2)**

Instructions

1. Use a separate page for each answer sheet using only one side of the paper. DO NOT write on the BACK of the answer sheet.
2. The question number and your ID Code should be shown clearly on each answer sheet

3. **ANSWER 4 OF 6 QUESTIONS ONLY**

4. Staple your question sheet to your answer sheets and turn in

**NRE Fusion**

**Answer any 4 of the following 6 questions**

**Question 1:**

It is generally desirable to have as large a value of energy confinement in a plasma as possible. In a tokamak the energy confinement time depends strongly on the plasma current, among other things. Discuss how the requirement for MHD kink mode stability sets a lower limit on the toroidal magnetic field strength required for a given plasma current. Calculate the minimum toroidal magnetic field B÷ that is required for a plasma current of I=5 MA in a circular cross section tokamak of Minor Radius r=a = 1.5m and major radius of R = 4 m.

**Question 2:**

Describe how you would calculate the D-T fusion power density in the tokamak of problem 1. What physics limits would need be taken into account in determining the maximum achievable power density?

**Question 3:**

Discuss ion orbit loss of thermalized ions in the outflowing plasma. What is it? How is it calculated? How does it affect the plasma parameters?

**Question 4:**

How are plasmas heated to thermonuclear temperatures? Discuss the physics of the principal heating mechanisms.

**Question 5:**

Discuss the physics processes involved in the plasma-wall interaction between the very energetic plasma and the material wall.

**Question 6:**

Describe how the plasma fluid equations are derived from the Boltzmann kinetic transport equations that describe the particle distribution functions.