# GEORGIA INSTITUTE OF TECHNOLOGY

The George W. Woodruff
School of Mechanical Engineering

## Ph.D. Qualifiers Exam – Spring Semester 2020

## Day 2: Plasma Physics

EXAM AREA

**Assigned Number (DO NOT SIGN YOUR NAME)**

- Please sign your name on the back of this page—

**Georgia Institute of Technology**

The George W. Woodruff School of Mechanical Engineering

Nuclear and Radiological Engineering/Medical Physics Program

PhD Qualifying Exam

**Spring 2020**

_____

(Your ID Code)

**NE Plasma Physics**

**(Day 2)**

**Instructions**

1. Use a separate page for each answer sheet using only the front side of the paper. DO NOT write on the back of the answer sheet
2. The **question nuclear and your ID Code** should be shown clearly on each answer sheet
3. **ANSWER 4 OF 6 Questions**
4. Staple your question sheet to your answer sheet and turn in

1. Discuss the calculation of the power balance in a burning (fusing) DT plasma. What are the important plasma heating and plasma cooling mechanisms, and in which part of the plasma are they each most important?

2. Discuss the most important MHD instabilities that might be expected in ITER, and how they might limit the operation of the plasma.

3. Discuss "ion orbit loss" of thermal ions in tokamaks. What are the basic mechanisms and effects?

4. Describe how a set of particle, momentum and energy transport equations to describe the performance of a tokamak plasma are derived from the Boltzmann transport equation.

5. A circular tokamak plasma with minor radius a = 2m and major radius R= 6m is being designed to have a toroidal magnetic field at the plasma center of $B_0 = 5T$. What is the maximum plasma current that can be safely achieved in this tokamak without risk of MHD kink mode instabilities?

6. Discuss how the tokamak of problem 5 could be heated to fusion temperatures.