# Introduction to Nuclear Fusion

(409.308A, 3 credits)
2nd Semester of 2010
Department of Nuclear Engineering

**Classroom:** Rm 32-108
**Time:** Monday, Wednesday 14:00 - 15:15
**Instructor:** Prof. Yong-Su Na (Rm 32-206, x 7204, ysna@snu.ac.kr)
**T.A.:** Mingu Yu (Rm 31-117, x 8336, hope123@snu.ac.kr)

**Overview:**

The lecture covers the basic principle of nuclear fusion and its commercial usage for energy production. Plasma confinement, transport, magnetohydrodynamic (MHD) and plasma heating and current drive are dealt with based on plasma physics. Various confinement concepts are introduced and compared with their historical background. Overview of fusion power plants, composed of the fusion reactor system, the heat transfer & fuel cycle system and the power conversion system is given. Critical issues and current status of fusion power plants development are addressed. Breakthroughs made in the nuclear fusion research are introduced with a particular focus upon tokamak, a magnetic confinement concept.

**Textbook:**

- A.A. Harms, K.F. Schoepf, G.H. Miley, D.R. Kingdon, "Principles of Fusion Energy", World Scientific Publishing Co. Pte. Ltd. (2000)
- G. McCracken, P. Stott, "Fusion The Energy of the Universe", Elsevier Inc. (2005)

**References:**

- F.F. Chen, "Introduction to Plasma Physics and Controlled Fusion, Volume 1: Plasma Physics", 2nd Edition, Springer (2006)
- J.A. Bittencourt, "Fundamentals of Plasma Physics", 3rd Edition, Springer (2004)
- B.B. Kadomtsev, "Tokamak Plasma: A Complex Physical System", Institute

of Physics Publishing Bristol and Philadelphia (1992)
- R.A. Gross, "Fusion Energy", John-Wiley (1984)
- W.M. Stacey, Jr., "Fusion An Introduction to the Physics and Technology of Magnetic Confinement Fusion", John-Wiley (1984)
- J. Feidberg, "Plasma Physics and Fusion Energy", Cambridge (2007)

**Evaluation Elements:**
- Attendance (10%), Homework (10%),
- Midterm Exam (30%), Final Exam (30%)
- Project (20%)

**Class Schedule**

| Week | Contents |
|---|---|
| 1 | Fundamentals of Nuclear Fusion Ⅰ - Present Status and Future Prospect |
| 2 | Fundamentals of Nuclear Fusion Ⅱ - Fusion Reactions |
| 3 | Fundamentals of Nuclear Fusion Ⅲ - Thermonuclear Fusion Conditions |
| 4 | Review of Plasma Physics - Plasma Confinement, Transport, Equilibrium, and Stability |
| 5 | Inertial Confinement |
| 6 | Magnetic Confinement - Mirror, Pinches, and Stellarator |
| 7 | Midterm Exam |
| 8 | Project Presentation Ⅰ |
| 9 | Tokamaks Ⅰ - Plasma Equilibrium and Stability |
| 10 | Tokamaks Ⅱ - Plasma Transport |
| 11 | Plasma Heating and Current Drive - OH, NBI, RF, Adiabatic Compression, and Alpha Self-heating |
| 12 | Plasma Wall Interaction |
| 13 | Overview of Fusion Power Plants |
| 14 | Critical Issues in Fusion Researches |
| 15 | Final Exam and Project Presentation |