Introduction to Nuclear Fusion

(409.308A, 3 credits)

2nd Semester of 2017

Department of Nuclear Engineering

Classroom: Rm 32-106

Time: Tuesday, Thursday 14:00 - 15:15

Instructor: Prof. Yong-Su Na (Rm 32-206, x 7204, ysna@snu.ac.kr)

T.A.: JungMin Ko (Rm 30-103, x 8336, kjm1211@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 in particle, fluid, and kinetic point of view based on plasma physics. Various confinement concepts are introduced and compared with their historical background. Overview of fusion power plants, composed of fusion reactor system, heat transfer & fuel cycle system and power conversion system is given. Critical issues and current status of fusion power plant 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/Attitude/Course Participation (10%), Homework (10%),
- Midterm Exam (40%), Final Exam (40%)

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 / Conference
4	Review of Plasma Physics - Single Particle, Kinetic, Fluid Approach, MHD Plasma Equilibrium, Stability, and Transport
5	추석
6	Inertial Confinement, Magnetic Confinement - Mirror
7	Midterm Exam
8	Magnetic Confinement - Pinches / KPS
9	Magnetic Confinement - Tokamak
10	Tokamaks I - Plasma Equilibrium and Stability (1)
11	ITPA CC Meeting
12	Tokamaks I - Plasma Equilibrium and Stability (2)
13	Tokamaks II - Plasma Transport
14	Plasma Heating and Current Drive - OH, NBI, RF, Adiabatic Compression, and Alpha Self-heating
15	Plasma Wall Interaction, Overview of Fusion Power Plants
16	Final Exam