Final Exam.

09:00-11:00 Dec. 18, 2007

1. (20points) Explain following terminologies :
   (a) diamagnetic current
   (b) magnetic flux surface
   (c) toroidal and poloidal betas
   (d) safety factor
2. (15points) Compare two simplest magnetic confinement concepts such as z- and theta-pinches for the following aspects:
   (a) Force balances from MHD equilibrium
   (b) Instabilities
   (c) Evolved toroidal configurations
3. (30points) A magnetic mirror field, confining a fusion plasma with fuel particle densities $N_d=N_t=4\times10^{19}m^{-3}$ at $T_i=30keV$, varies from $B_{max}=6T$ at its throats to $B_{min}=1T$ at the mid-plane.
   (a) What is mirror ratio?
   (b) What are conserved quantities of ion motion in this configuration?
   (c) Derive loss cone angle.
   (d) Find the number of ions escaping through the loss cones.
4. (20points) (a) List all instabilities in a simple mirror configuration and (b) explain how to stabilize these instabilities.
5. (20points) (a) Explain in terms of particle drift motions why a simple toroidal magnetic field cannot confine high-temperature plasma particles. (b) To avoid this knid of particle loss from drift motions, poloidal magnetic fields are implemented as a closed magnetic confinement systems. Explain two well-known confinement concepts operating in this way.
6. (15points) (a) List tokamak instabilities with their free energy sources such as pressure or current. (b) What is considered as a main cause of tokamak plasma beta limit among those instabilities? (c) List magnetic coils and compare magnetic field strength of those coils in a typical tokamak device.
7. (20points) (a) Describe roles of blanket in fusion reactor. (b) What materials should be used as components of fusion blanket?
8. (10points) When do you think commercial fusion power plant will be realized? Is that changed after taking this class? If so, explain why.