NSE Fusion Oral Exam Mandatory Question. Feb 2018

1. Write down and explain the Vlasov equation governing the velocity distribution function of electrons in a plasma. Specifically:

(a) Define the parameters and differential operators.

(b) State the conditions for this equation to apply, and what changes to the equation are necessary when those conditions are violated.

(c) Consider a plasma in uniform, magnetic-field-free, equilibrium, perturbed by a plane wave of small amplitude. Solve the linearized Vlasov equation to find the perturbation to the distribution function.

(d) Explain how Landau damping arises.

2. Enthusiasts often propose some sort of colliding beam configuration, thinking it can be used to produce fusion energy.

Explain why they are mistaken, stating clearly the important phenomena, and giving in outline the equations governing them.

Mention one scheme of this type, of which you are aware, that suffers from the fundamental weaknesses of beam fusion.

Why is neutral beam injection heating of magnetically confined plasmas (a beam fusion scheme, in a sense) not subject to the same critique?