SEMICONDUCTOR PHYSICS **ECE 1336**

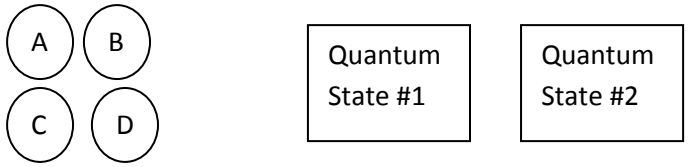
Problem Set #5: Statistical Mechanics

1.

(a) Explain the difference(s) in the conditions of particles that can be described by the Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein distributions.

(b) Provide an example of a particle which obeys (i) Maxwell-Boltzmann distribution, (ii) Fermi-Dirac distribution, and (iii) Bose-Einstein distribution.

(c) There exists an isolated system consisting of four particles which can occupy two distinct quantum states. Assuming these particles obey Maxwell-Boltzmann statistics, determine the probability of ***each*** possible distribution of the four particles among the two quantum states. Assume no degeneracy.



2. Consider the density of states per unit energy, g(E), of a free-electron gas is given below. Calculate the number of states in a $1cm^3$ volume between the energies of 0 and 1eV:

$$g(E)dE = \frac{8\sqrt{2}\,\pi V}{h^3} m^{3/2}\sqrt{E}\,\mathrm{dE}$$

where V is the volume containing the gas and m is the mass of an electron.

3. Show that for a particle which obeys Fermi-Dirac statistics, the probability of a state a distance ΔE above E_f being filled is the same as the probability of a state a distance ΔE below E_f being empty.