Extra problem for week 4 - 2017

Consider a quantum dot where the lowest single particle orbitals have the energies: $\varepsilon_1 = \varepsilon_2 = 1$ *meV*, $\varepsilon_3 = \varepsilon_4 = 5$ *meV* (each orbital is now non-degenerate since spin-degeneracy has been included explicitly). The charging energy is $E_C = 5$ *meV*.

(a) Find the total energy $E(N)$ for $N = 1, 2, 3, 4$ electrons on the dot. Then find also the corresponding chemical potentials and addition energies. Assume here that all voltages are zero.

(b) Assume equal capacitances to left and right lead, $C_L = C_R$, and a gate capacitance $C_g = 2C_L$, and assume that the voltage is applied symmetrically, $V_L = -V/2$, $V_R = V/2$. Sketch first the current as a function of the gate voltage at small V, then draw the full stability diagram $dI(V, V_g)/dV$. Only draw the edges of the Coulomb diamonds, i.e., identify the regions with zero current, don't care about lines inside the conducting regime which originate from excited states. Indicate the height and width of each Coulomb diamond, as well as how many electrons reside on the dot there.