ME 301: HW Assignment 4 – (50 points)

1. Calculate the size (radius) of the critical nucleus for pure iron when nucleation takes place homogeneously. For iron, $\gamma = 204\times10^{-7}$ J/cm^2, $\Delta H_f = -2098$ J/cm^3, $T_m = 1808$ K. Plot the critical radius vs. ΔT, for $0 < \Delta T < 0.2\ T_m$ at intervals of $0.02\ T_m$. **(10 points)**

2. Calculate the number of atoms in a critically sized nucleus for the homogeneous nucleation of pure iron. Take appropriate value(s) from problem 1. Assume lattice constant for Fe (BCC), a = 0.28664 nm. Plot the number of atoms vs. ΔT, for $0 < \Delta T < 0.2\ T_m$ at intervals of $0.02\ T_m$. **(10 points)**

3. Distinguish between a substitutional solid solution and an interstitial solid solution. Determine whether small amounts of 1) carbon in iron, 2) silicon in aluminum, and 3) copper in aluminum are substitutional or interstitial solid solutions. **(10 points)**

4. Calculate the radius of the largest interstitial void in the BCC α iron lattice. The atomic radius of the iron atom in this lattice is 0.124 nm, and the largest interstitial voids occur at the (¼, ½, 0); (½, ¾, 0); (¾, ½, 0); (½, ¼, 0), etc., type positions. **(10 points)**

5. Describe and illustrate the edge and screw-type dislocations. What types of strain fields surround both types of dislocations? **(5+5 = 10 points)**