**INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY**

**Department of Metallurgical Engineering and Materials Science**

**MM 202: THERMODYNAMICS : 2019-20: Fall**

**Quiz II: 55 minutes Date: Oct 22, 2019**

1. (a) 0.03 wt% silicon in iron is in equilibrium with pure silica (solid) and dissolved oxygen at 1950K. What is the dissolved oxygen content ? Assume Henry’s law is followed by solutes.

2 marks

(b) Now the melt is cooled to 1800K without any additional oxygen being available. What are now the oxygen and silicon contents in wt%? Mol. Wt: Si :28, O2 : 32

2 marks

1. An liquid iron alloy has the following composition. Take temperature to be 1873 K

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Elements | C | Si | Mn | S | P | Al |
| Wt.% | 2.0 | 1.0 | 0.8 | 0.03 | 0.02 | 0.03 |

1. Calculate the Henrian activity coefficient γi/γio ( with respect to 1wt% Henrian solution) of C and Si in liquid steel. ( 1 marks)
2. What is the pO2 in equilibrium with (i) this carbon and CO(1atm.) (ii) with this silicon and SiO2(pure solid) ( 2 marks)
3. If a H2/H2O mixture is brought in equilibrium with this alloy, what is the H2/H2O molar ratio ? (3 marks)

BONUS for 3 marks (no part marking)

1. For Germanium and Silicon, the data for melting are as follows:

Si(s) = Si(l); = 50600 − 30.07T, J/mol

Ge(s) = Ge(l); = 36800 – 30.33T, J/mol

Germanium and silicon are fully miscible in the solid and the liquid states (they form an isomorphous system).

One can also assume that the solid as well as liquid solutions can be considered ideal if the pure solids and the liquids respectively are taken as the standard states. Calculate the silicon content in the equilibrium solid and liquid solutions at 1600K. **(3 marks)**