Donald P. Shiley School of Engineering
EGR 221 Materials Science
Assignment 10, Fall 2015

1. a) Define or describe the differences between "phase" and "microstructure".
   b) What are the differences and/or similarities between "eutectic α" and "primary α".
   c) What is another name for primary α, and primary cementite ("super-hint", primary cementite is also known as proeutectoid cementite).

2. a) Describe the crystal structure of austenite (aka γ-iron), ferrite (aka α-ferrite) and cementite (aka Fe_3C, aka iron carbide). What is the maximum amount of carbon that can be dissolved in each?
   b) What is the relative hardness and toughness of ferrite (aka α-ferrite) and cementite (aka Fe_3C, aka iron carbide)?

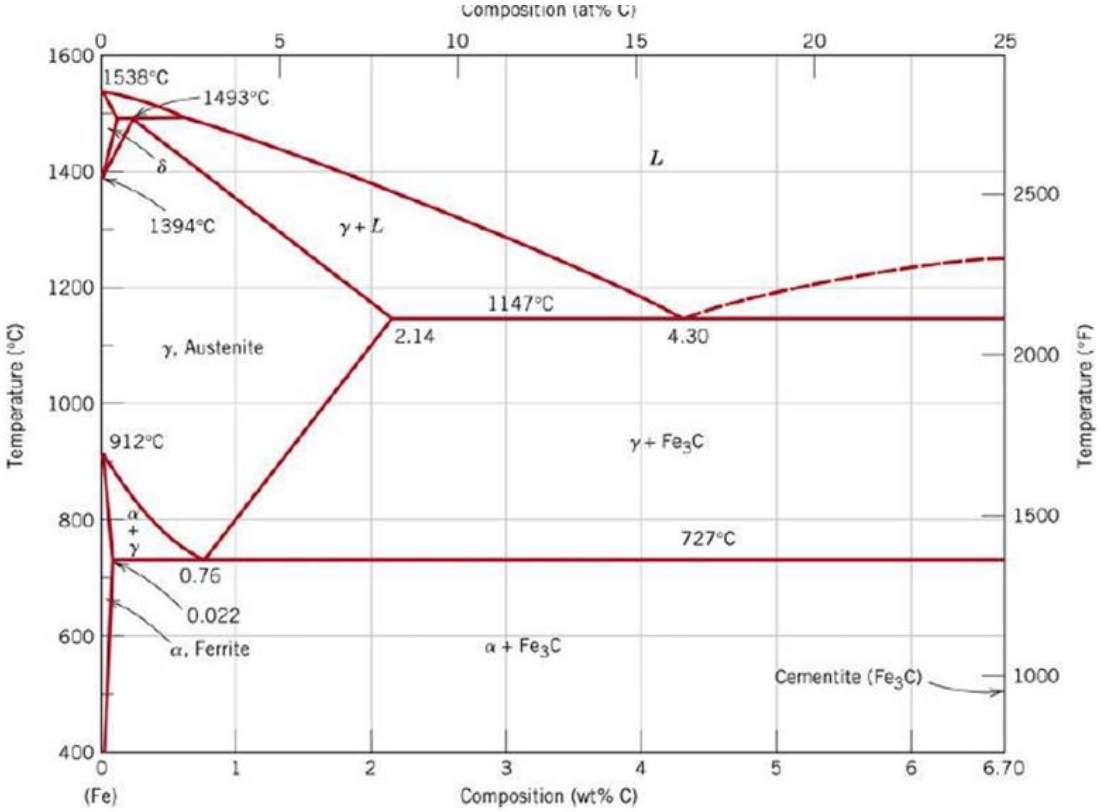
3. a) What is a eutectic reaction?
   b) What is a eutectoid reaction? How is it similar and/or different than a eutectic reaction?

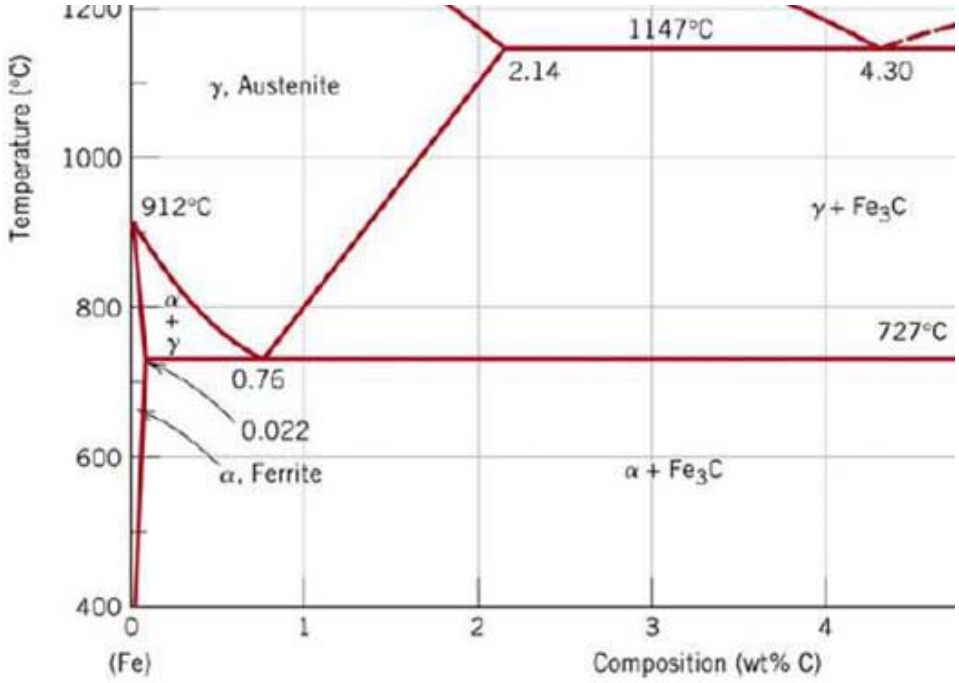
4. a) We have learned that the microstructure that forms as a result of a eutectic reaction is generally referred to as a "eutectic microstructure." Often, eutectic microstructure's morphology are layers of each phase "stacked" together. For Fe-Fe_3C, the eutectoid microstructure is specifically referred to as pearlite (because it resembles mother-of-pearl – look it up, if you don't know what that is). Compute the mass fractions (or weight fraction) of α ferrite and cementite (Fe_3C) in pearlite.
   b) By mass, what is the composition of α-ferrite at room temperature (20°C)? What is it at 720°C?
   c) By mass, what is the composition of cementite at room temperature (20°C)? What is it at 720°C.

5. a) What is the distinction between hypoeutectoid and hypereutectoid steels?
   b) In a hypoeutectoid steel, both eutectoid ferrite and primary ferrite exist. Explain the difference between them. What will be the carbon concentration in each?

6. Consider 10 kg of austenite containing 0.6 wt% C, cooled to below 727°C (1341°F).
   (a) What is the proeutectoid phase – which is it: primary α or primary cementite?
   (b) How many kilograms each of total ferrite and cementite form?
   (c) How many kilograms each of pearlite and the proeutectoid phase form?
   (d) Schematically sketch and label the resulting microstructure.

7. ~~Additional problems may be added depending upon lectures~~….nope, we're good for now.


Composition (at% C)
0
5
10
15
20
25
1600
1400
1200
1000
800
600
400
1538°C
1493°C
δ
1394°C
L
γ + L
1147°C
2.14
4.30
γ, Austenite
912°C
γ + Fe3C
α + γ
727°C
0.76
0.022
α, Ferrite
α + Fe3C
Cementite (Fe3C)
2500
2000
1500
1000
Temperature (°C)
Temperature (°F)
0
1
2
3
4
5
6
6.70
(Fe)
Composition (wt% C)


1200
1000
800
600
400
Temperature (°C)
1147°C
2.14
4.30
γ, Austenite
912°C
γ + Fe3C
α + γ
727°C
0.76
0.022
α, Ferrite
α + Fe3C
0
1
2
3
4
(Fe)
Composition (wt% C)