Carbon is non-metallic in nature and has a density of 2.5g/c.c. The melting point of Carbon is 3500°C. Pure Iron is a ductile metal. It is exists in different forms (α, γ and δ-form). α-Fe is stable at low temp. (upto 910 °C). At very high temp., δ-Fe is stable. (above 1392 °C). The melting point of Fe is 1537°C.

At 727°C, ferromagnetic $\rightleftharpoons$ paramagnetic

At 910°C, α-Fe $\rightleftharpoons$ γ-Fe

At 1392°C, γ-Fe $\rightleftharpoons$ δ-Fe.

Phases observed in Fe-C diagram:-

(I) α-Ferrite:- Solid solution of carbon in α-Fe. It has a BCC structure. Maximum Solubility of Carbon is 0.02%. α-Ferrite is soft and ductile. It is stable at low temp.

(II) γ-Austenite:- Solid solution of carbon in γ-Fe. It has a FCC structure. Maximum solubility of Carbon = 2.14%. It is normally not stable at room temp. It is non-magnetic and soft.

(III) δ-Ferrite:- Solid solution of of carbon in δ-Fe. It has a BCC. Structure. Maximum Solubility of Carbon = 0.1%. It is stable at high temp.

(IV) Cementite:- Fe_3C (iron carbide). It Contains 6.67% Carbon. It is very hard and brittle.

Phase mixtures observed in Fe-C diagram:-

(I) Pearlite:- It is eutectoid mixture of α-Ferrite and Cementite. Average Carbon Content is 0.76%.

(II) Ledeburite:- It is Eutectic mixture of γ-Austenite and Cementite. Average Carbon Content is 4.3%.

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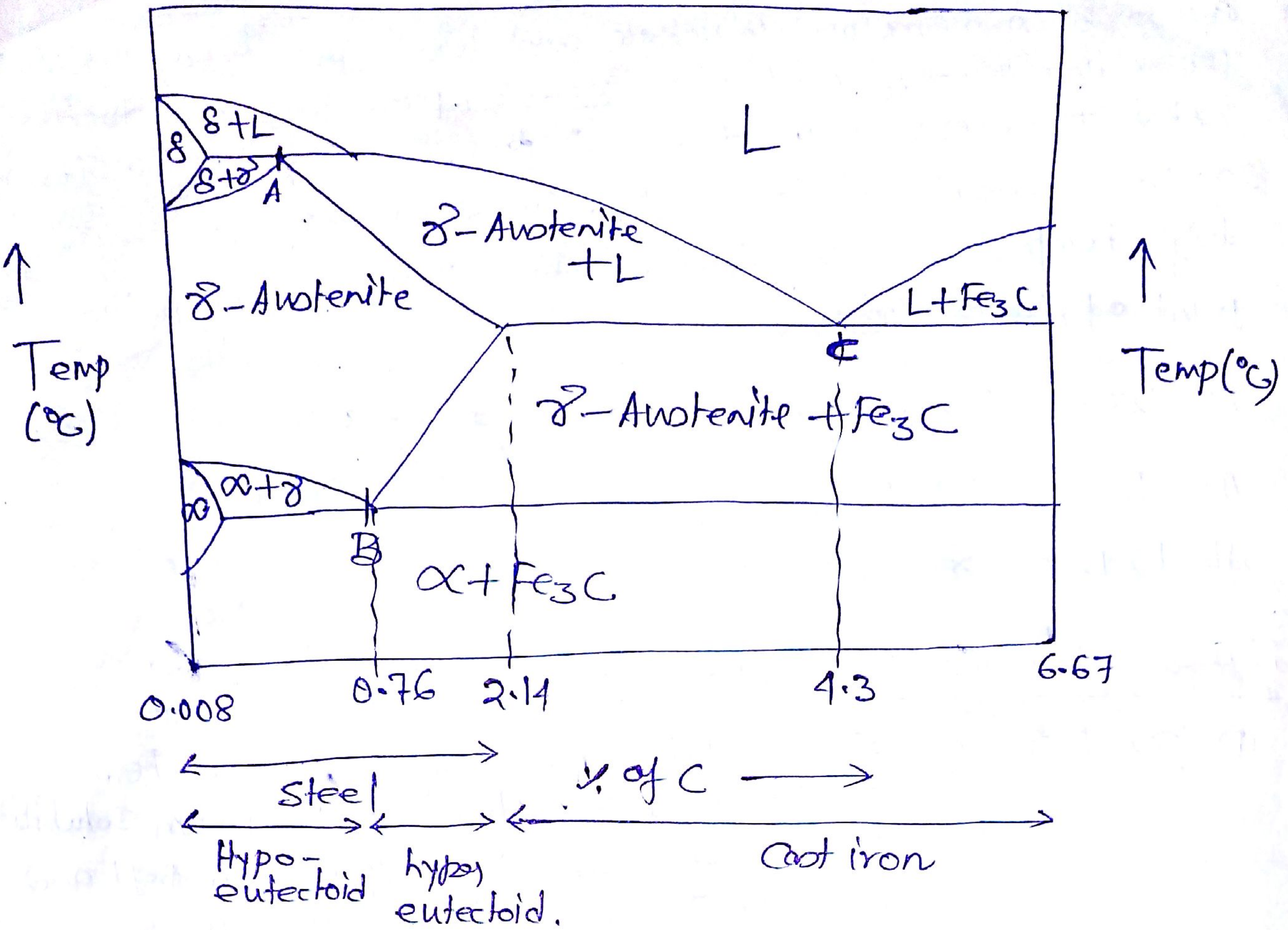

L = Liquid (Fe + C).

α = α- Ferrite

γ- Austenite

δ = δ- Ferrite.

C ⇒ it is called Eutectic point. (Temp = 1147°C
4.3 wt % C)

Eutectic rxn :-

$$\underset{\text{Iron}}{\text{Liquid }(4.3\%\,C)} \rightleftharpoons \underbrace{\underset{(2.14\%\,C)}{\gamma\text{-Austenite}} + Fe_3C}_{\text{Ledeburite}}$$

Degrees of Freedom = 0

Point B It is called Eutectoid point.

Temp. = 727°C, ~~wt%~~ 0.76% wt C
↙ Eutectoid ↙ Eutectoid Composition

Eutectoid rxn

γ - Austenite (0.76% C) $\rightleftharpoons$ α - Ferrite (0.02% C) + Cementite (Fe_3C).

$\underbrace{\quad\quad\quad\quad}_{\text{pearlite.}}$

$\boxed{F = 0}$

Point A :- It is called peritectic point.

peritectic Temp. = 1493°C, 0.16% wt C ← peritectic Composition

Peritectic rxn :-

δ - Ferrite (0.1% C) + Liquid iron (0.5% C) $\rightleftharpoons$ γ - Austenite (0.16% C).

Degrees of Freedom (F) at peritectic point = 0

Eutectic rxn It is an isothermal reversible rxn in which two metals are completely soluble in liquid state but completely insoluble in solid phase. Hence below the eutectic point, they crystallize as alternate layers of solid structures.

$$\text{Liquid} \underset{\text{Heating}}{\overset{\text{Cooling}}{\rightleftharpoons}} (\text{Solid})_1 + (\text{Solid})_2$$

Example :- Liquid iron (4.3% C) $\rightleftharpoons$ γ - Austenite + Cementite (Ledeburite).

~~Solid~~ Solution of Ag + Pb $\rightleftharpoons$ Solid Pb + Solid Ag.

Eutectoid Reaction :- It is an isothermal and reversible reaction in which a solid phase forms two new solids.

$$(\text{Solid})_1 \underset{\text{Heating}}{\overset{\text{Cooling}}{\rightleftharpoons}} (\text{Solid})_2 + (\text{Solid})_3$$

Example :- $\boxed{\gamma\text{ - Austenite} \rightleftharpoons \alpha\text{ Austenite} + \text{Cementite}}$

Peritectic rxn:- It is an isothermal reversible rxn in which a solid and a liquid reacts to form a new solid.

$$\text{Liquid} + (\text{Solid})_1 \underset{\text{Heating}}{\overset{\text{Cooling}}{\rightleftharpoons}} (\text{Solid})_2$$

Example:- Liquid iron (0.5% C) + δ-Ferrite (0.1% C) ⇌ γ-Austenite (0.16% C).

Similarities between Eutectic and peritectic point:-

(i) Both peritectic and eutectic points occur in alloy system with limited solubility

(ii) In both the points, degrees of freedom is zero. i.e, they are invariant system.

Eutectic point	Peritectic point
(i) It occurs in alloy system with metals having comparable melting points.	(i) It occurs in alloy system with metals having large difference in melting points.
(ii) It is the lowest ~~melting~~ point attainable and is lower than the melting point of both the metals.	(ii) It is in between the melting point of both the metals.
(iii) It is characterized by $L \rightleftharpoons S_1 + S_2$. Two solids are present below eutectic point.	(iii) It is characterized by $L + S_1 \rightleftharpoons S_2$. Only one solid is present below the peritectic point
(iv) Example:- ~~γ-Austenite~~ Liquid iron (4.3% C) ⇌ γ-Austenite (2.14% C) + Cementite	(iv) Example:- Liquid iron + δ-ferrite ⇌ γ-Austenite.

Peritectoid rxn:- It is an isothermal rev. rxn in which two solid phases react with each other to form a new solid

$$(\text{Solid})_1 + (\text{Solid})_2 \underset{\text{Heating}}{\overset{\text{Cooling}}{\rightleftharpoons}} (\text{Solid})_3.$$