27/4/2022

ME8491 - Engineering Metallurgy
Assignment - I

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2020 PECME 171
II - C
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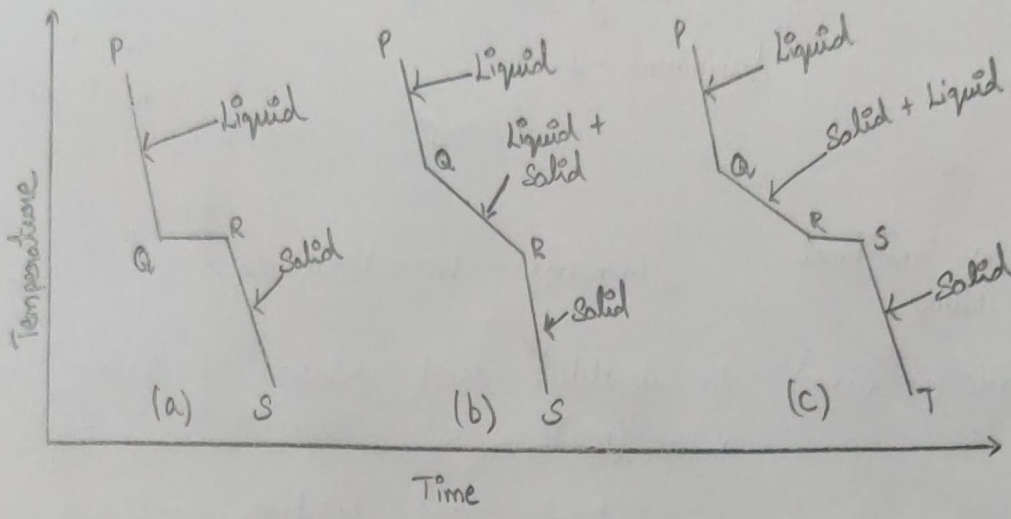
11) a)

S.No	Micro - Constituent Name	General Characteristics
1.	Ferrite (or α iron)	An interstitial solid solution of Carbon in α iron (BCC).
2.	Austenite (or γ iron)	An interstitial solid solution of Carbon in γ iron (FCC).
3.	Cementite	A Compound of iron and Carbon (Fe_3C).
4.	Pearlite	Eutectoid of ferrite and Cementite with a lamellar microstructure of alternate α iron and Cementite plates.
5.	Ledeburite	Eutectic mixture of austenite (γ iron) and Cementite (Fe_3C).
6.	Martensite	An interstitial solid solution of Carbon in ferrite (α iron).
7.	Troostite	A mixture of radial lamellae of ferrite and Cementite.
8.	Sorbite	A mixture of ferrite and finely divided Cementite.
9.	Bainite	Eutectoid of ferrite and Cementite. The ferrite has either a feathery appearance or occurs as plates. Carbide particles lie between the ferrite regions.

12)a)



a) Cooling Curve for pure metal or compound:

* From P to Q, the Curve proceeds at a uniform rate and at point Q, the first Crystals begain to form.

* As solidification proceeds, the latent heat of fusion is liberated in such amount that the temperature remains constant from Q to R until whole mass has entirely solidified. The period QR is known as the horizontal thermal arrest.

* Further cooling from point R will cause the temperature to drop along Curve RS. The slopes of PQ and RS Curves depends upon the specific heats of liquid and solid metals respectively.

* In the region PQ, only liquid phase is present while in the region RS only solid phase is present.

(b) Cooling Curves of a binary solid solution:

* Curve portion PQ is similar in character to that for pure metal.

* The slope of the Cooling Curves will change due to the evolution of latent heat of Crystallisation.

* Beyond point R, there will be only solid phase and the temperature falls along line RS.

(c) Cooling Curve of a binary eutectic system:

* A binary eutectic system has two components that are Completely soluble in the liquid state but entirely insoluble in the solid state.

* The system is liquid along PQ upto point Q.

* At point Q, the temperature drops along QR and crystalisation of one component starts.

* At point R, the liquid composition reaches such a level that two components crystallise simultaneously from the solution and the temperature remains constant until all the liquid solidifies.

* Thus eutectic reaction can be defined as the transformation, during cooling, of a liquid phase isothermally and reversibly into two solid phases.

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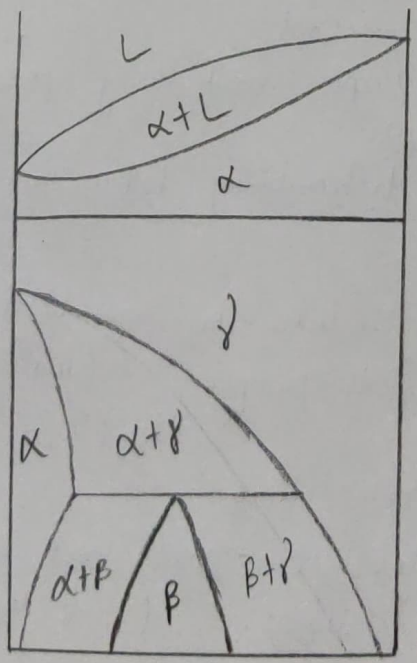
12) b) Peritectoid Reaction:

* Peritectoid reaction is an isothermal reversible reaction in which two solid phases transform into a third solid phase, upon cooling.

* Solid 1 + Solid 2 $\underset{\text{Heating}}{\overset{\text{Cooling}}{\rightleftharpoons}}$ Solid 3

* The peritectoid is an 'upside-down' eutectoid.

* Peritectoid systems are found in Ni-Zn, Fe-Nb, Cu-Sn, Ni-Mo, and many other systems.



Peritectoid
($S_1 + S_2 \longrightarrow S_3$)

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11) b) (a) Malleable Cast Iron:

Composition:

Components	Percentage
Carbon	2.0 - 2.65 %
Silicon	0.9 - 1.4 %
Manganese	0.25 - 0.55 %
phosphorus	< 0.18
Sulphur	0.05

Properties:

* Similar to ductile iron
* Good shock resistance
* Good ductility
* Good machineability.

Application:

* Malleable iron is beter for thinner castings.
* Vehicle Components [Good Machinability]
  - Power trains, frames, suspensions and wheels.
  - Steering components, connecting rods.
* Railway components [Good Tensile strength]
* Pipe fitting [High ductility].

(b) Spheroidal Cast Iron:

Composition:

Iron Carbon	3.3 to 3.4 %
Silicon	2.2 to 2.8 %
Manganese	0.1 to 0.5 %
Magnesium	0.03 to 0.05 %
phosphorus	0.005 to 0.04 %
Sulphur	0.005 to 0.02 %

Properties:

* Strength higher than grey cast iron
* Ductility up to 6% as cast or 20% annealed
* Low Cost
* Simple manufacturing process makes Complex shapes.
* Machineability better than steel.

Applications:

* Major industrial applications include - highway diesel trucks, - agricultural tractors, - oil well pumps. (High strength)
* Pipe and pipe fittings used for water and sewer lines.
* Machinery products: - Crankshafts, - front wheel spindle supports, - Steering knuckles, - disc brake Callipers. (Good Machinability).