Micro Constituents of Steel:-

Constituent of steel as seen under the microscope may be classified as:-

1- **Ferrite: -** It is the name given to the grains or crystals of solid solution of carbon in α iron. The solubility of carbon in α iron is 0.025% melted at 732°C. When low carbon steel (less than 0.8% C) cool slowly from temperature above or within critical range, it consist chiefly of ferrite. (Properties) it is ductile, highly magnetic and it has a low tensile strength of approximately 2800 Kg/cm2.

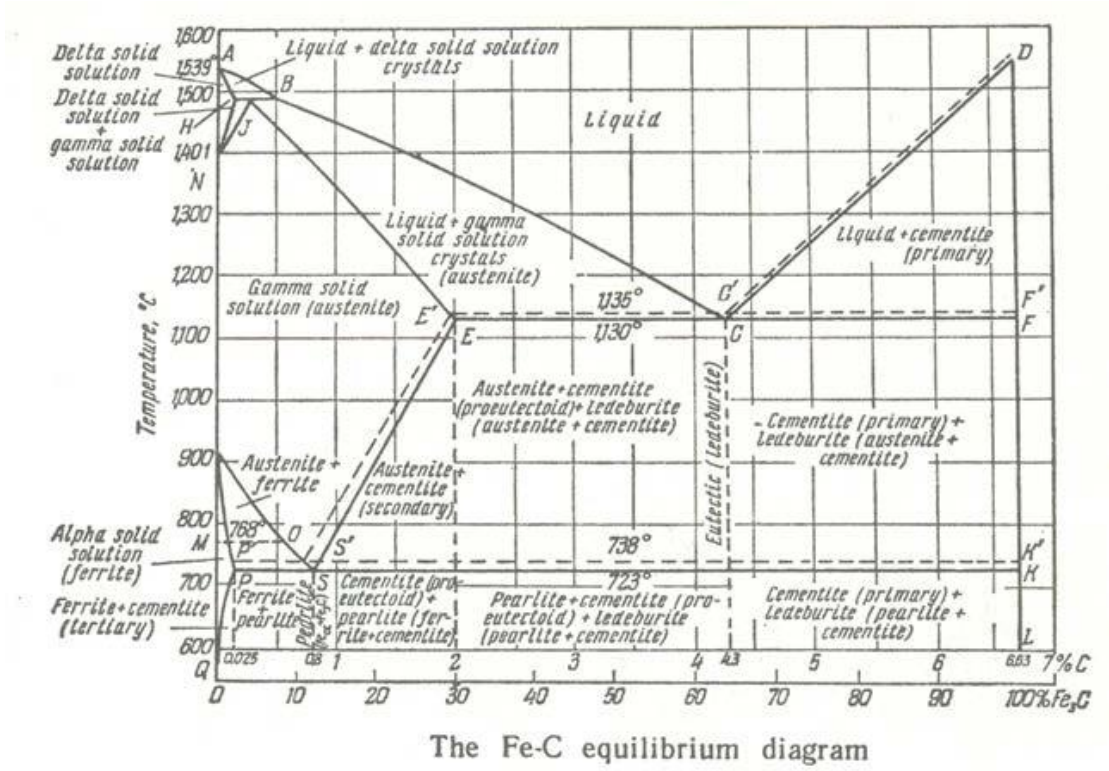
2- **Cementite:** - It is a product which contains 6.67% carbon and 93.33% iron by weight. It is found in steel containing over 0.8% carbon when it cools slowly from (r just above) the critical alloy. The amount of cementite increase with increasing the percentage of carbon in iron. It is identify round particles in the structure. (Properties) it is extremely highly brittle and magnetic below 210 ºC.

3- **Pearlite: -** It is a mechanical structure of about (87% ferrite + 13% cementite). It is found in all steels when cool slowly under 723 ºC. Steel with 0.8% carbon is wholly pearlite. The soft steel contains less than 0.8% carbon containing ferrite + pearlite which is hard. Steel contains more than 0.8% carbon and (pearlite + cementite). The structure of pearlite consists of thin alternating plates of cementit and ferrite. (Properties) it is strong metal, may be cut reasonably well with cutting tool and it has tensile strength of 8750 Kg/cm2.

4- **Austenite: -** It is a solid solution of carbon or iron carbide (Fe3C) in γ iron. When low carbon steel is heated, its constituent remains particles "doesn't change" until reaching under the critical

temperature 723 ◦C. At this temperature, the pearlite contain of the metal get completely changed into the new substance austenite. On farther heating the metal higher than the critical temperature, the remaining ferrite or cementite is observed by austenite. The maximum solubility of carbon in austenite is 1.7% at 1130 ◦C. (Properties) it is generally soft, ductile, non- magnetic and it is denser than ferrite.

Iron- Carbon Equilibrium Diagram: -



The Fe-C equilibrium diagram

Hypoeutectoid steels: -

The modified iron – carbon diagram has the following important curves which are: -

1- Curve ACD: - It represents the variation in temperature (corresponding to the percentage of carbon in iron) at which the solidification processes start when the iron cool from its molten. This curve is known as liquidus as it indicates that the iron above the curve is in its liquid or molten state. The point A represents the start of solidification process of the iron (with 0% carbon at 1539 ◦C). Similarlythe point C represents the start of solidification processes of iron (with 4.3% carbon at 1130 ◦C). Also the point D represents the iron containing 6.7% carbon, I starts to solidify at a temperature higher than 1539 ◦C. This point is not of much particle important.

2- **Curve AECF: -** It also represents the variation in the temperature from A to E and ECF corresponding to the percentage of carbon in iron at which the solidification processes is completed when the iron is cold from its molten state. This curve is known as (solidus) as it indicates that the iron below this curve exit in solid state. The point A represents that the iron with the 0% carbon is solidify at 1539◦C. Similarly the points E, C and F indicate that the iron contain 0.7%, 4.3% and 6.7% carbon respectively solidify completely at 1130 ◦C.

3- **Curve GSE: -** It also represents the variation in temperature according to the percentage of carbon in the iron at which the transformation process from austenite into a mixture of austenite and ferrite or austenite and cementite starts, when the iron cool from a temperature above the curve GSE to a temperature below it. The points G, S and E represent the start of transformation process of iron with 0% carbon, 0.8% carbon and 1.7% carbon respectively.

4- **Curve GPQ: -** It also represents the variation in temperature (according to the percentage of carbon in iron) at which the transformation process from austenite to ferrite completed, when the iron cools from a temperature above the curve GP to a temperature below it. Similarly the curve PQ represents the transformation of a little part of ferrite into cementite, while the remaining part remains as ferrite when the iron is farther cool from a temperature above the curve PQ to a temperature below it. The points G, P and Q represent the iron with 0% carbon, 0.025% carbon and 0.0025% carbon.

5- **Curve PSK: -** It represents a constant temperature line (corresponding to the percentage of carbon in iron) at which the transformation processes from a mixture of austenite and ferrite or austenite and cementite into a mixture of ferrite and cementite completed when the iron cool from a temperature above the curve

PSK to a temperature below it. The points P, S and K represent the iron contain 0.025% carbon, 0.8% carbon and 6.67% carbon.

Notes: -

This graph, which is known as iron- carbon equilibrium diagram has the following important points: -

1- The percentage of carbon is between 0% and 6.67%.

2- Iron contains carbon from 0% to 1.7% known as steel.

3- Steel contains carbon up to 0.8% known as hypoeutectoid steel and the steel contains carbon from 0.8% to 1.7% known as hypereutectoid steel.

4- Iron contains carbon more than 1.7% known as cast iron.