- From this curve we observe that temperature remains constant at 768°C, 910°C, 1395°C, 1539°C and we know that in a cooling curve if temperature remains constant then it is accompanied by phase change.
- Thus these are 4 allotropes of Fe, namely α, β, γ, $\delta-$ and their property are shown in figure.
- From figure we observe that at 768°C (this temperature is called curie temperature) only magnetic property of iron is disappeared and structure remains same. Hence this transformation is not considered as phase transformation i.e. in Fe–C system we only consider α-ferrite, γ-austenite, δ-ferrite

3.12 PHASES OF IRON AND STEEL

1. Ferrite or α - Iron

(i) It is solid solution of carbon and iron. Carbon present is upto 0.02% i.e., solubility of carbon in α-iron is 0.02%.

(ii) It is pure iron at room temperature. It has BCC structure.

(iii) It is soft and ductile.

(iv) It is magnetic under 768°C.

(v) Maximum solubility of carbon is 0.02% at 723°C and at room temperature solubility is only 0.008%.

(vi) The carbon atom is too small for substitution and too large for interstitial solution, that is why solubility of carbon is less.

2. Pearlite

(i) Pearlite increases the strength of steel.

(ii) It is of lamellar structure i.e., it has alternate layers of ferrite and cementite.

(iii) It is a mixture of 87.5% ferrite and 12.5% cementite.

(iv) Pearlite is relative strong, hard and ductile while ferrite is weak, soft and ductile.

(v) Steel with 0.8% carbon is wholly pearlite. When carbon content is less that 0.8%, it is called hypo-eutectoid steel. It contains ferrite and pearlite and it is soft.

With carbon content more than 0.8%, it is called hyper-eutectoid steel. It contains pearlite and cementite. It is hard and brittle.

(vi) Hard steels are mixture of pearlite and cementite.

3. Austenite or γ - Iron

(i) It is soft, tough, highly ductile malleable and non-magnetic

(ii) It has FCC structure.

(iii) It has low tensile stress.

(iv) It is much suited for fabrication processes. Most of the rolling and forging work is done above 1150°C.

(v) Maximum solubility of carbon in γ-iron is 2.14%

(vi) Carbon atoms are accommodated at interstitial spaces; as it has large interatomic spacing than does ferrite.

4. δ - Iron

(i) It has BCC structure, because beyond 1400°C, FCC structure of iron, again changes to BCC structure.

(ii) The solubility of carbon is very small but it is larger than α-iron. The solubility is more because of high temperature.

(iii) The δ-region is not of much importance to industry because no heat treatment process is done at this temperature range.

5. Cementite or Iron Carbide

(i) It is a chemical compound of iron and carbon, of composition Fe_3C.

(ii) It is of orthorhombic structure.

(iii) It is non-ductile and brittle.

(iv) It has low tensile strength but high compressive strength.

(v) It is very hard and brittle. The strength of steel is greatly increased by its presence.

(vi) It is magnetic upto 210°C.

(vii) It has carbon content upto 6.67%

(viii) Its unit cell has 12 iron atoms and 4 carbon atoms.

(ix) The melting point of pure iron is 1539°C while the melting point of cementite is 1500°C.

6. Ledeburite

(i) Ledeburite is a eutectic mixture of austenite and cementite. It contain 4.3% carbon.

(ii) It is rarely seen in slowly cooled alloys because it breaks down, due to its unstable nature, into other phases during cooling, after solidification.