UNIT-II - HEAT TREATMENT

PART- A

1. **What is "critical cooling rate" in hardening of steels?**

   This critical cooling rate, when included on the continuous transformation diagram, will just miss the nose at which the pearlite transformation begins

2. **What is meant by "heat treatment"? Also its purpose.**

   Heat treatmentof a metal or alloyis a technological procedure, including controlled heating and cooling operations, conducted for the purpose of changing the alloy microstructure and resulting in achieving required properties.

3. **What is meant by normalizing? Also its purpose.**

   An annealing heat treatment called normalizing is used to refine the grains (i.e., to decrease the average grain size) and produce a more uniform and desirable size distribution; fine-grained pearlitic steels are tougher than coarse-grained ones.

4. **What is quenching? List some of the quenching medium.**

   Conventional heat treatment procedures for producing martensitic steels ordinarilyinvolve continuous and rapid cooling of an austenitized specimen in some type ofquenching medium, such as water, oil, or air.

5. **What is the process in Full Annealing?**

Annealing is a heat treatment procedure involving heating the alloy and holding it at a certain temperature (annealing temperature), followed by controlled cooling.

6. **What is the Spheroidizing?**

   Spheroidizing. For steels, a heat treatment carried out at a temperature just below the eutectoid in which the spheroidite microstructure is produced.

7. **What is Normalising?**

   Normalizing. For ferrous alloys, austenitizing above the upper critical temperature, then cooling in air. The objective of this heat treatment is to enhance toughness by refining the grain size.

8. **What is the abbrevation of TTT-diagram?**

   T-T-T diagram is also called isothermal transformation diagram. It is a plot of temperature versus the logarithm of time for a steel alloy of definite composition. It is used to determine when transformation begin and end for an isothermal (constant temperature) heat treatment of a previously austentized alloy.

9. **What is meant by aging?**

   A heat treatment used to precipitate a new phase from a supersaturated solid solution. For precipitation hardening, it is termed artificial aging.

10. **Define the term age hardening.**

    The term as applied to soft or low carbon steels, relates to slow, gradual changes that take place in properties of steels after the final treatment. These changes, which bring about a condition of increased hardness, elastic limit, and tensile strength with a consequent loss in ductility, occur during the period in which the steel is at normal temperatures.

11. Briefly notes on Martempering.

The process of quenching an austenitized ferrous alloy is a medium at a temperature in the upper part of the martensite range, or slightly above that range, and holding it in the medium until the temperature throughout the alloy is substantially uniform is known as martempering. The alloy is then allowed to cool in air through the martensite range.

12. What is age hardening or precipitation hardening?

By uniformly dispersing extremely small particles within the original phase matrix the strength and hardness of metal alloys may be enhanced; this process of heat treatment is called precipitation hardening or age hardening.

13. What is meant by heat treatment? What are the different methods of heat treatment?

Heating and cooling a solid metal or alloy in such a way as to obtain desired conditions or properties is called heat treatment. There are different methods of strengthening and hardening by heat treatment.

They are

- Age hardening (precipitation hardening)
- Annealing
- Normalizing
- Tempering and
- Case hardening

14. What are cast irons and what are their basic types?

Any ferrous alloy made up primarily of iron with about 2% or more carbon is considered to be cast iron. Most commercial alloys contain from about 2.5% to 3.8% carbon. There are four basic types of cast iron

- Grey cast iron
- White cast iron
- Malleable iron

15. Differentiate annealing and normalizing treatment.

Annealing	Normalizing
a) A generic term used to denote a heat treatment wherein the microstructure and, consequently, the properties of a material are altered. b) ‘‘Annealing’’ frequently refers to a heat treatment whereby a previously cold-worked metal is softened by allowing it to recrystallize.	a) For ferrous alloys, austenitizing above the upper critical temperature, then cooling in air. b) The objective of this heat treatment is to enhance toughness by refining the grain size.

16. What do you mean by hardenability?

A measure of the depth to which a specific ferrous alloy may be hardened by the formation of martensite upon quenching from a temperature above the upper critical temperature.

PART-B

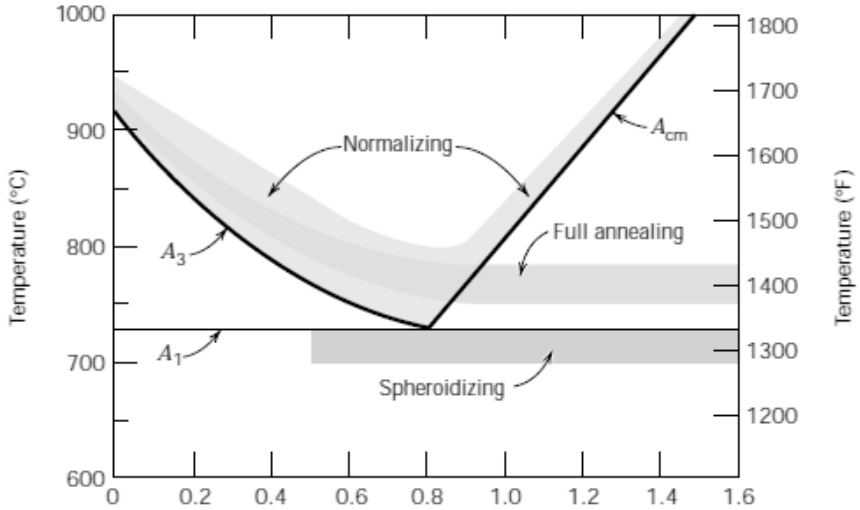
1. **What is heat treatment? And explain the various stages of heat treatmentprocess.**

Hints:

- Heat treatment of a metal or alloy is a technological procedure, including controlled heating and cooling operations, conducted for the purpose of changing the alloy microstructure and resulting in achieving required properties.
- There are two general objectives of heat treatment: hardening and annealing.
- **Hardening** is a process of increasing the metal hardness, strength, toughness, fatigue resistance.
- **Annealing** is a heat treatment procedure involving heating the alloy and holding it at A certain temperature (annealing temperature), followed by controlled cooling.

2. **Describe Normalizing process of heat treatment.**

Hints:



- Steels that have been plastically deformed by, for example, a rolling operation, consist of grains of pearlite (and most likely a proeutectoid phase)
- Normalizing is accomplished by heating at approximately 55 to 85°C (100 to 150°F) above the upper critical temperature, which is, of course, dependent on composition.

3. **Explain the process of martempering .Compare and constrast it with austempering.**

Hints:

- Martempering is used to minimize distortion and cracking.
- It involves cooling the austenized steel to temperature just above Ms Temperature, holding it there until temperature is uniform.
- Cooling at a moderate rate to room temperature before austenite-to-bainite transformationbegins.
- The final structure of martempered steel istempered Martensite.
- Austempering involves austenite-to-bainite transformation.
- Thus, the final structure of austempered steel is bainite.

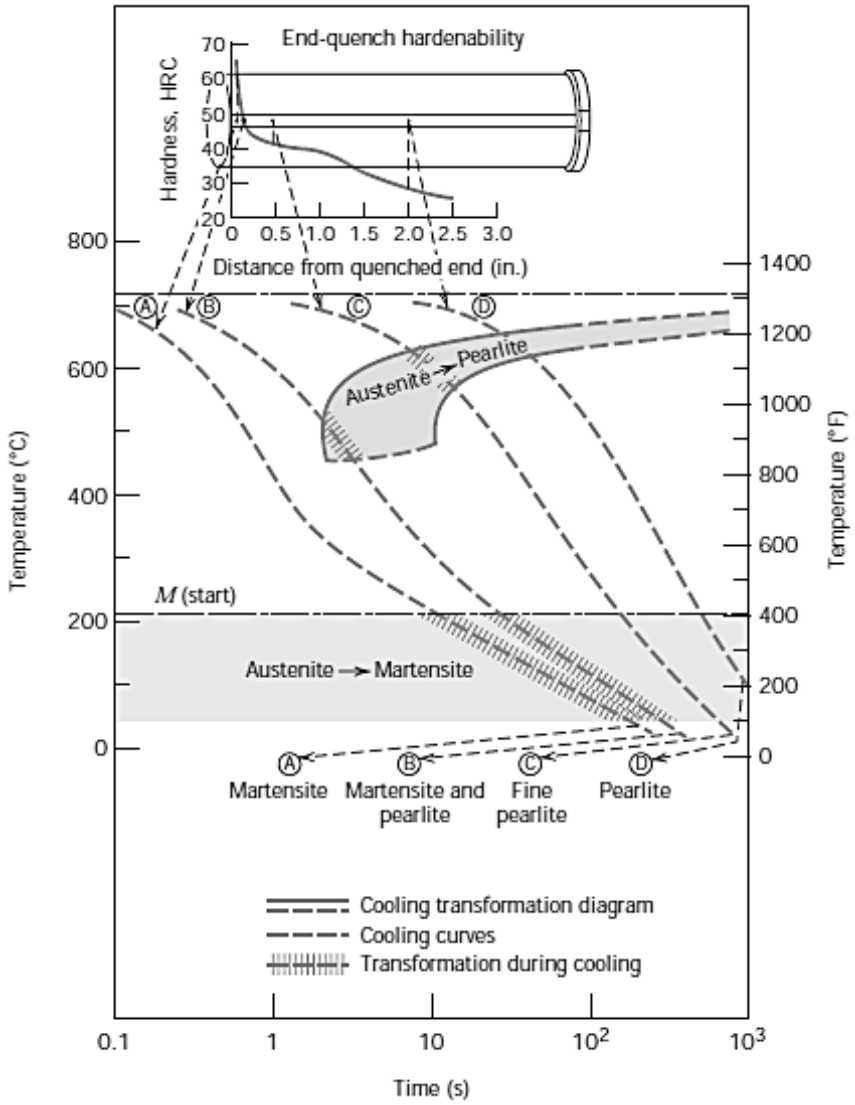
4. **Differentiate between hardness and hardenability.**

Hints:

- The influence of alloy composition on the ability of a steel alloy to transform to martensite for a particular quenching treatment is related to a parameter called hardenability.
- Hardenability is not ‘‘hardness,’’ which is the resistance to indentation; rather, hardenability is a qualitative measure of the rate at which hardness drops off with distance into the interior of a specimen as a result of diminished martensite content

5. **Discuss the uses of hardenability curves.**

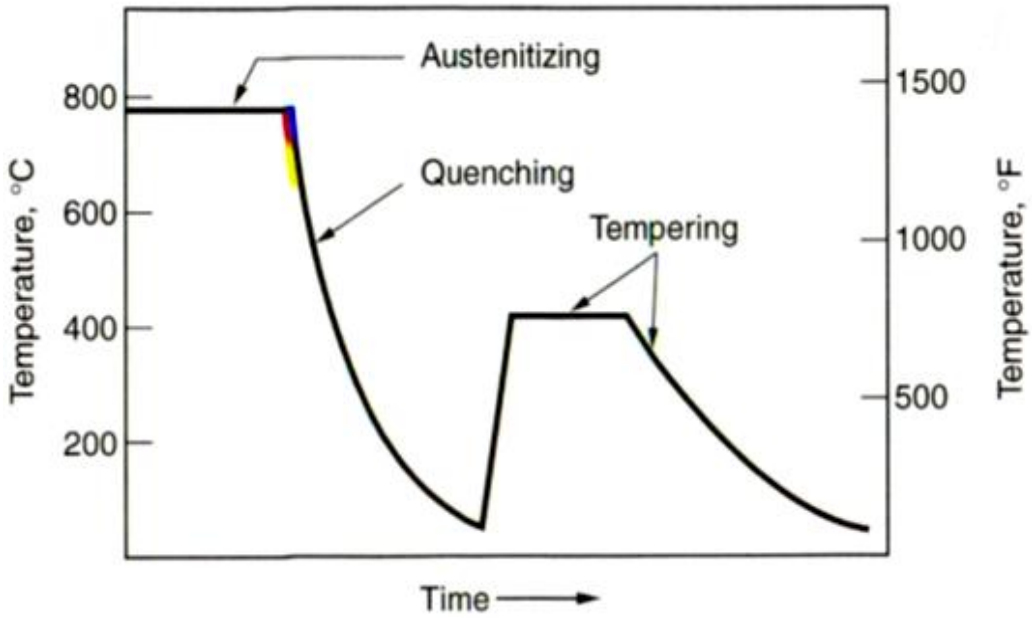
Hints:



- The quenched end is cooled most rapidly and exhibits the maximum hardness; 100% martensite is the product at this position for most steels.
- Cooling rate decreases with distance from the quenched end, and the hardness also decreases.
- With diminishing cooling rate more time is allowed for carbon diffusion and the formation of a greater proportion of the softer pearlite
- It is mixed with martensiteand bainite.

6. **Explain various tempering process.**

Hints:

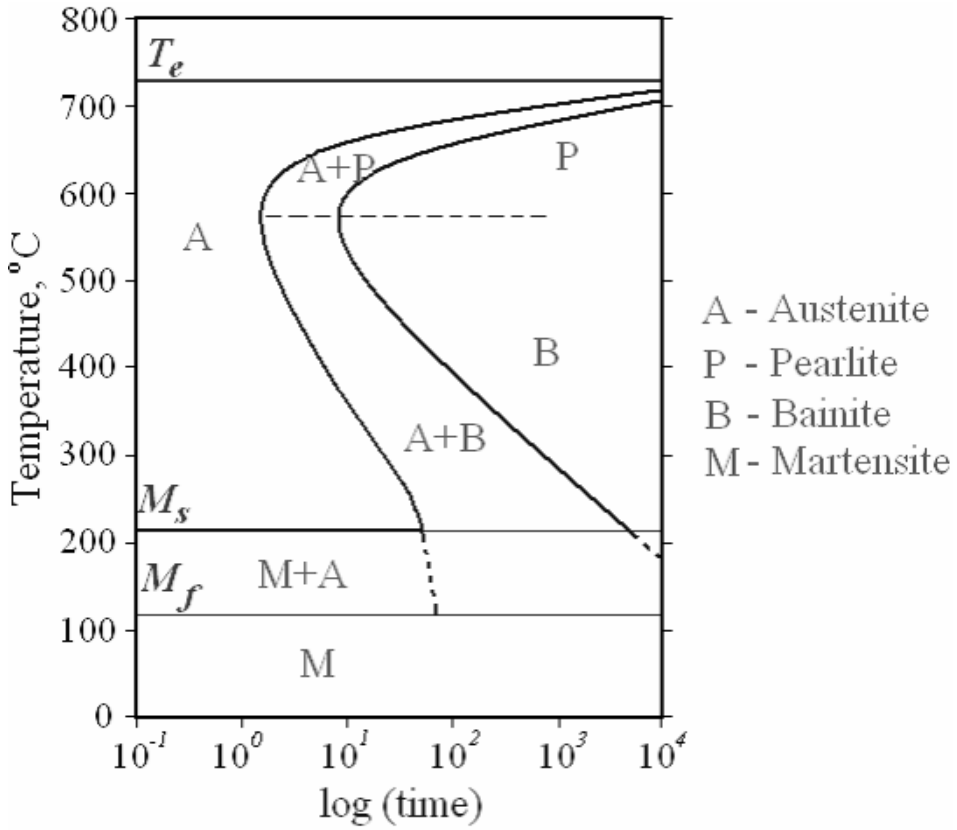


Martensite (BCT, single phase) ⟶ Tempered Martensite (+ α Fe3C phases)

- The microstructural product resulting from a tempering heat treatment of martensitic steel.
- The microstructure consists of extremely small and uniformly dispersed cementite particles embedded within a continuousferrite matrix.
- Toughness and ductility are enhanced significantly by tempering.

7. **What are TTT diagrams? How its drawn?**

Hints:



- Heat Treatment is the controlled heating and cooling of metals toalter their physical and mechanical properties without changing theproduct shape.
- T-T-T diagram is also called isothermal transformation diagram.
- It is a plot of temperature versus the logarithm of time for a steel alloy of definite composition.
- It is used to determine when transformation begin and end for an isothermal (constant temperature) heat treatment of a previously austentized alloy.

8. What is a CCT diagram? And write short notes on critical cooling rate.

- For the continuous cooling of a steel alloy, there exists a critical quenching rate, which represents the minimum rate of quenching that will produce a totally martensitic structure.
- This critical cooling rate, when included on the continuous transformation diagram, will just miss the nose at which the pearlite transformation
- Each is experimentally determined for an alloy of specified composition, the variables being temperature and time.