

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION MO/2023)**

CLASS: B. Tech
BRANCH: MECHANICAL AND PIE

SEMESTER : III
SESSION : MO/2023

SUBJECT: PE214 METALLURGICAL AND MATERIALS ENGINEERING

TIME: 03 Hours

FULL MARKS: 50

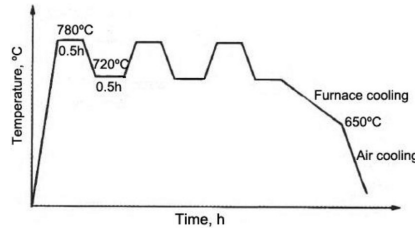
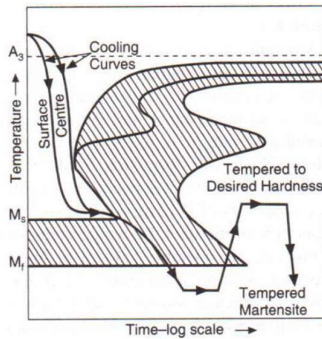
INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

- Q.1(a) I. An example of a metal having BCC, FCC and HCP structure could be _____, _____, _____, respectively. [2+2+1] CO1 BL3
- II. "A 100% perfect crystal is unlikely and less stable" - Explain the statement with a suitable reason.
- III. Calculate the atomic packing fraction of face centered cubic crystal structure.
- Q.1(b) I. "Polymers are mostly insulators while metals are conductors" - Justify the statement with suitable logic. [2+1 x3] CO1 BL3
- II. Name any three net-shape or near-net-shape processing methods.
- III. An experimental method to determine crystal structure is _____.
- IV. A method to produce a metallic rod from a bloom is called _____.
- Q.2(a) I. "Martensite does not appear in the Fe-Fe₃C equilibrium phase diagram" - Justify the statement with suitable reasons. [2+3] CO2 BL3
- II. Study the given adjacent phase diagram and identify the following: (A) solvus lines, (B) solubility limit of A in B, (C) solubility limit of B in A, (D) type of transformation at 'c' and (E) phases in the diagram.
- Temperature ↑
A → Composition B
- Q.2(b) I. State the main difference between ideal and regular solution. [1+2+2] CO2 BL2
- II. Calculate the volume change (in %) as FCC γ -Fe changes to BCC α -Fe. [Given atomic radii of γ -Fe and α -Fe are 1.270 Å and 1.241 Å, respectively. For FCC: $\sqrt{2}a = 4r$ and for BCC: $\sqrt{3}a = 4r$] BL3
- III. Draw a schematic Fe-Fe₃C equilibrium phase diagram and mark the following: (a) AC₁, (b) AC₃, (c) AC_m, (d) Eutectic isotherm, (e) Eutectoid isotherm
- Q.3(a) I. Discuss the main differences between TTT and CCT. [2+2+1] CO3 BL2
- II. Differentiate between ausforming and austempering.
- III. A method to produce new and small strain free grains from a highly cold rolled sheet is called _____.

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- Q.3(b) I. Identify the heat treatment process shown in the adjacent diagram: [1x3 CO3 BL4
+2] BL2
- II. The following heat treatment process where the accompanying microstructure change takes place is known as _____



- III. Martensite transformation occurs by _____ mechanism where atoms move by _____ of interatomic distances.
- IV. “Normalizing of steel yields finer grain size than that after annealing” - Explain briefly why?

- Q.4(a) I. The principal strengthening mechanism of vulcanization of rubber is [1x5] CO4 BL2
_____.

- II. State 2-3 important applications of magnesium alloys.
- III. Glass ceramic is thermal shock resistant due to _____ phases dispersed in _____ matrix.
- IV. Process to develop residual compressive stress on a silicate glass panel is called _____.
- V. Ledeburite is an invariant transformation product of _____ change in cast iron.

- Q.4(b) I. A method to consolidate powders into a strong solid is _____. [1x3 CO4 BL1
+2]
- II. “Melting and casting is not usually adopted for ceramics” - Explain why?
- III. Semiconductor device fabrication is always done under a high vacuum - why?
- IV. Differentiate between thermoplastic and thermosetting polymer.

- Q.5(a) I. Show the important points related to mechanical properties of a solid on a stress - strain diagram. [1x3 CO5 BL2
+2]
- II. State the main difference yield strength and hardness.
- III. Discuss the causes of photoelectric emission.
- IV. Mark and identify the important points on a B-H diagram that are usually compared to differentiate between a hard and soft magnet.

- Q.5(b) I. Define creep. State the various stages of creep mentioning the most catastrophic stage. [2+ CO5 BL2
1x3]
- II. With rise in temperature, viscosity _____ but diffusivity _____.
- III. During cold working, hardness _____ while ductility _____.
- IV. Electrical resistance is proportional to _____ and inversely proportional to the _____ of a conducting wire.