VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Mechanical Engineering

CAT- II, Winter Semester 2018- 2019,

B.Tech. *Mechanical Engineering*,

Class Nbr : VL2018195002124/ VL2018195002278/VL2018195002068
Course Name : Materials Engineering & Technology **Duration** : 90 Minutes.
Course Code : MEE1005 **Max. Marks** : 50
Slot : B2
Faculty In-Charge(s): *Dr. Ariful Rahaman/ Dr. Narendrakumar. U/Dr. Rijesh. M*

(Answer **all the questions**)

1. Sketch a typical eutectic phase diagram with components A and B having similar melting points. B is much more soluble in A (maximum = 15%) than A is in B (maximum = 5%), and the eutectic composition occurs near 40% B. The eutectic temperature is 2/3 of the melting point. Label the axes of the diagram. Label all the phases. Use α and β to denote the solid phases.
For an overall composition of 60% B, list the sequence of phases found as the liquid is slowly cooled to room temperature and cite the composition of each phase just above the eutectic temperature. **[10M]**

2. For the binary system Cu-Ni the following data is available from cooling experiments:

Temp (°C)	Liquidus Point (wt % of Ni)	Solidus Point (wt % of Ni)
1100	3	10
1180	20	37
1260	40	57
1340	60	79
1410	80	87

(i) From this data, construct the phase diagram (Temp (T) vs composition (C)).

(ii) At each of the following (T, C) coordinates in below, i.e., combinations of temperature and composition, what are the phases present and what are their respective compositions?

(a) T = 1120°C, C_o = 15 wt% Ni; (b) T = 1200°C, C_o = 55 wt% Ni; (c) T = 1300°C, C_o = 60 wt% Ni **[10M]**

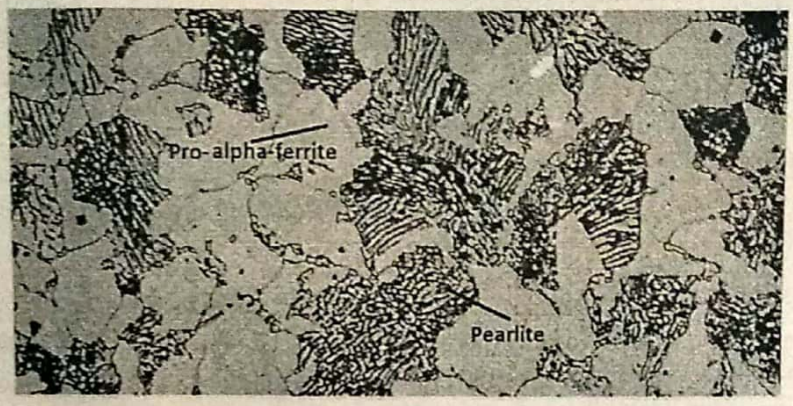
3. Suppose three medium carbon steel samples (P, Q, and R) of 0.5 wt% carbon each are equilibrated at 1000°C.
(i) Draw a well labelled sketch of the microstructure of these samples (at 1000°C).
(ii) Suppose sample 'P' is quenched in water from 1000°C to room temperature. Draw a well labeled sketch of the microstructure of sample "P" after quenching.

(iii) Suppose sample 'Q' is cooled from 1000°C to 730°C (just above the eutectoid temperature), equilibrated at 730°C, and then quenched in water from 730°C to room temperature. Draw a well labelled sketch of the microstructure of sample 'Q' after quenching.

(iv Suppose sample 'R' is cooled in furnace from 1000°C to room temperature. Draw a well labelled sketch of the microstructure of sample 'R' after cooling in furnace.

(v) Rank the three samples in terms of their hardness from highest to lowest after each has reached room temperature. Briefly justify this ranking. **[10M]**

4. Following is a micrograph of steel, the lighter phase is proeutectoid α ferrite and the darker layer is Fe_3C.



Is it a eutectoid, hypoeutectoid or hypereutectoid steel? Assuming the weight fraction of proeutectoid phase to be 0.55, determine the composition of the steel. What is the upper critical transformation temperature (approximate) and lower critical transformation temperature of the above steel? **[10M]**

5. Using T-T-T diagram for an eutectoid steel alloy, determine and draw the final microstructure of a small specimen subjected to the following time temperature treatments. In each case the specimen begins at 800°C and that has been held at this temperature long enough to have achieved a complete and homogeneous austenitic structure:

(a) Rapidly cool to 250°C, hold for 960 s, then quench to room temperature

(b) Rapidly cool to 600°C, hold for 7 s, then quench to room temperature

(c) Rapidly cool to 400°C, hold for hold for 1000s, then quench to room temperature

(d) Rapidly cool to 700°C, hold for 10 s, then quench to room temperature

(e) Rapidly cool to 550°C, hold at this temperature for 5 s, then quench to room temperature

(f) Rapidly cool to 350°C, hold for 300 s, then quench to room temperature

[10M]