SCHOOL OF MECHANICAL ENGINEERING

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

Continuous Assessment Test : II Fall Semester 2019-2020

Programme Name & Branch: B.TECH. (BEM/BMA/BME/BPI)

Course Name & Code: Materials Engineering & Technology (MEE1005)

Class Number: *VL2019201001078; VL2019201001567; VL2019201001633; VL2019201001401; VL2019201001835; VL2019201000897*

Slot: B1

Exam Duration: 90 mins

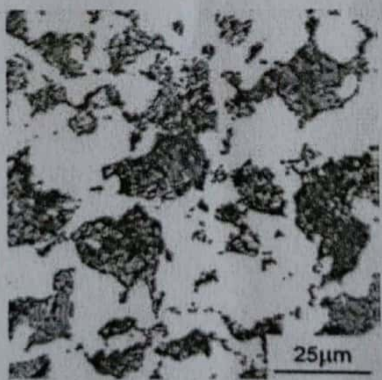
Maximum Marks: 50

(Answer <u>all the questions</u>)

1. A 55 wt% Ni–45 wt% Cu alloy is heated to a temperature within the α + liquid phase region. If the composition of the α phase is 55 wt% Ni (approximate), determine (i) the temperature of the alloy, (ii) the composition of the liquid phase (approximate), (iii) the weight fractions of both phases, (iv) draw the microstructure and (v) calculate the degree of freedom. Use the Cu-Ni phase diagram. [10 M]

2. A binary eutectic alloy having 28 wt % Cu & balance Ag solidifies at 779°C. The soild consists of two phases α & β. Phase α has 9% Cu whereas phase β has 8% Ag at 779°C. At room temperature these are pure Ag & Cu respectively. Sketch the phase diagram. Label all fields & lines. Melting points of Cu & Ag are 1083° & 960°C respectively. Estimate the amount of α & β in the above alloy at 779°C & at room temperature. [10 M]

3. Following is a micrograph of steel, the lighter phase is ferrite and the darker phase is pearlite. Pure iron cooled slowly contains 100% ferrite; the eutectoid composition contains 100% pearlite.



Is it a eutectoid, hypoeutectoid or hypereutectoid steel? Determine the composition of the steel (approximate). What is the lower critical transformation temperature and upper critical transformation temperature (approximate) of this steel? [10 M]

4. Using the T-T-T diagram for eutectoid steel, draw the specified cooling path on the diagram. Indicate what phases you expect in the final product with percentage of each phase. Assume the material has been fully austenitized before cooling.

(i) Rapidly cool to 350°C, hold for 10^3 seconds, then quench to room temperature

(ii) Rapidly cool to 625°C, hold for 10 seconds, then quench to room temperature

(iii) Rapidly cool to 300°C, hold for 900 seconds, then quench to room temperature

(iv) Rapidly cooled to 250◦C, held at this temperature for 100 seconds, then quenched to room temperature

(v) Rapidly cool to 650°C, hold for 1800 seconds, then quench to room temperature, then heat to 700°C, hold for 24 hours and then cool to room temperature.

(vi) Rapidly cool to 560°C, hold for 100 second, then quench to room temperature, then heat to 700°C, hold for 24 hours and then cool to room temperature.

(vii) Draw and explain the difference between the microstructures of (v) and (vi). [10 M]

5. The iron-carbon phase diagram allows the engineer to design a wide range of steels with specific properties for different applications. Using the partial Fe-C phase diagram below as required , explain, as quantitatively as possible, how you would obtain the following by heat treatment and write composition of each steel.

(i) a hypoeutectoid steel composition which contains 10wt% of proeutectoid cementite.

(ii) spheroidite in a eutectoid steel

(iii) steel composition which contains 100 wt% of martensite

(iv) a hypereutectoid steel composition which contains 20 wt% of cementite and 80 wt% of martensite.

(v) a hypereutectoid steel composition which contains 20 wt% of cementite and 80 wt% of coarse pearlite.

[10 M]