I D NO.	

PRESIDENCY UNIVERSITY, BENGALURU

SCHOOL OF ENGINEERING

Weightage: 40 % Max Marks: 80 Max Time: 2 hrs. 11th May 2018, Friday

ENDTERM FINAL EXAMINATION MAY 2018

Even Semester 2017-18 Course: **MEC 205 STRUCTURE AND PROPERTIES OF MATERIALS** IV Sem. Mechanical

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Instructions:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted

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Part A

(5 Q x 4 M = 20 Marks)

1. What is stainless steel? Name the major alloying element present in it. How does this alloying element prevent corrosion in steel.
2. Briefly explain any two methods to achieve Nano materials.
3. What is plain carbon steel? State the types of plain carbon steel with the average percentage of carbon present in it.
4. Define Austempering and Martempering of steel stating the phase achieved in each process.
5. What are the different types of composite materials.

Part B

(3 Q x 10 M = 30 Marks)

6. Define the process of normalizing, Quenching and Tempering using suitable plot. Enlist are the properties achieved in each of the above processes.
7. Describe the following mechanical properties in detail with the help of suitable Engineering stress – strain curve:
   (a) Ductility

(b) Toughness and

(c) Resilience.

8. Explain why ceramics are brittle. Enlist the typical properties of ceramics and any three common practical applications.

Part C

(2 Q x 15 M = 30 Marks)

9. What is Annealing? Explain the entire process using suitable Temperature Vs Time curve. Elaborate how stress free grains are formed by the process of recovery, recrystallization and grain growth.
10. Describe tension test conducted for Mild steel specimen highlighting the following details
    a) Specimen
    b) Procedure.
    c) Resulting engineering stress strain curve.
    d) Phenomena taking place in various parts of the curve.

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Weightage: 20% Max Marks: 40 Max Time: 1 hr. 26 March Monday 2018

TEST – 2 **SET A**

Even Semester 2017-18 Course: **MEC 205 Structure and Properties of Materials** IV Sem. Mechanical

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Instruction:

(i) Read the question carefully and answer accordingly.
(ii) The question paper consists of 2 parts.
(iii) Scientific and Non-programmable calculators are permitted.
(iv) Answer to the point.

Part A

(5 Q x 4 M = 20 Marks)

1. Define degrees of freedom and Gibbs Phase rule defining all the terms involved. Calculate the degrees of each section of the cooling curve (P=1 atm = const) shown in Figure 1 and explain the result.
2. Enlist two characteristics and two uses of Phase Diagrams.
3. How does Hume-Rothrey Rules for maximum solid solubility explain the solubility of Silver in Copper?
4. Construct the binary isomorphous phase diagram of Cu – Ni system. Melting point of Copper is 1083^{0}C whereas that of Ni is 1455^{0}C. Schematically show the microstructure development of the 50% Cu alloy starting from liquid phase to room temperature.

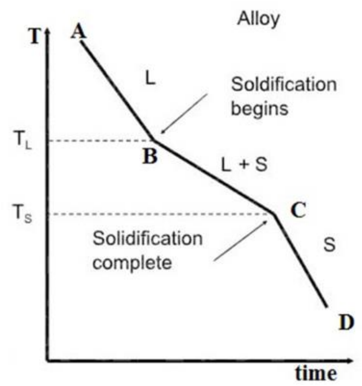

Figure 1: Cooling curve for solid solution

5. Describe the mechanism of dendritic growth and how it results in a multi-grain structure with the help of neat sketch.

Part B

(2 Q x 10 M = 20 Marks)

6. For the Lead-Tin (Pb-Sn) phase diagram shown in the Figure 2, schematically explain the microstructure development for 25% tin alloy for the points indicated on the constant composition line (1 to 4).
Also for 1 Kg of 25% tin alloy calculate the following: (4 + 2 + 2 + 2 = 10 Marks)
   a) Weight of pro-eutectoid α present just before Eutectic transformation (in Kg).
   b) Weight of total α phase present just after eutectic transformation (in Kg).
   c) Percentage of Pro-Eutectoid α phase in total α phase present just after eutectic transformation.

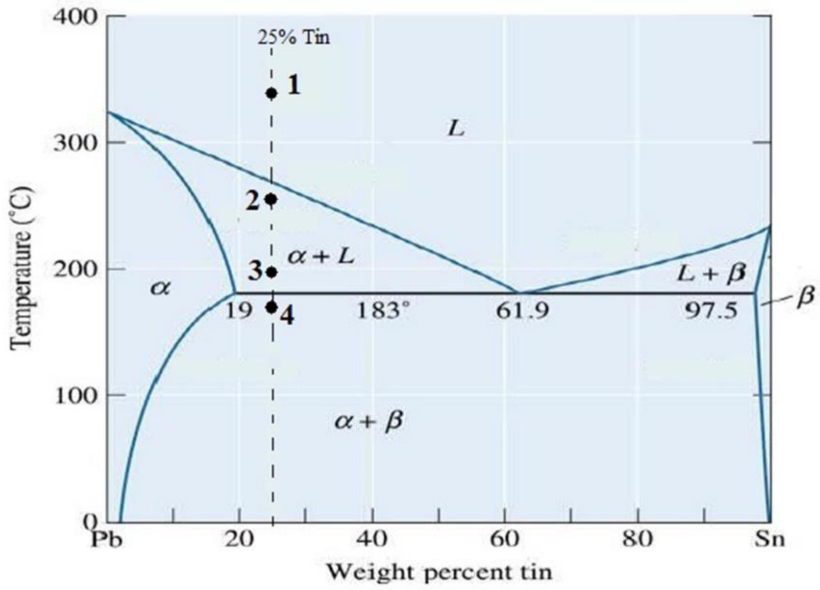

Figure 2: Lead-Tin Phase Diagram.

7. The Figure 3 shows the Skelton of the Iron-Carbon equilibrium phase diagram. Draw the complete figure representing the α, y, δ and Cementite phases present in different parts of the figure, along with the various two-phase regions present in the diagram and the temperatures. Mention the three Invariant reactions taking place in Fe – Fe_3C Phase Diagram along with the reaction temperature and the composition of each phase present in the reactions.

(4+2+2+2 = 10 Marks)

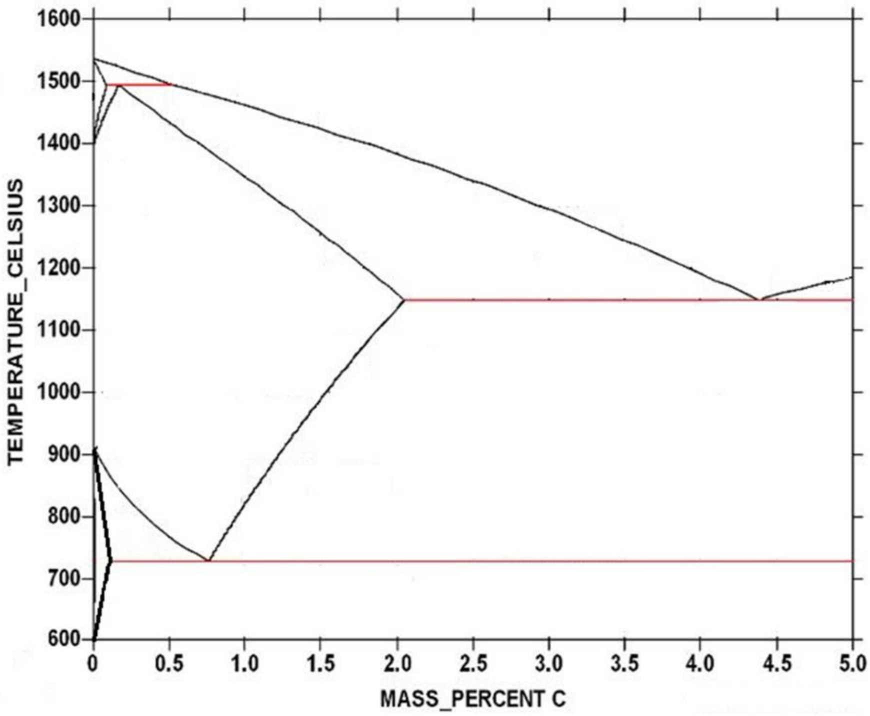

Figure 3: Iron-Carbon Phase Diagram Skelton

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Weightage: 20 % Max Marks: 40 Max Time: 1 hr. 21 Feb Wednesday 2018

TEST – 1

Even Semester 2017-18 Course: **MEC 205 Structure and Properties of Materials** IV Sem. Mechanical

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Instruction:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted.
(iv) All problems and calculations must be supported with suitable equations.
(v) Answer to the point.

Part A

(5 Q x 2 M = 10 Marks)

1. State any two differences between Screw and edge dislocation.
2. Explain why creep in metals is closely related to diffusion.
3. Define Frenkel and Schottky defects with the help of neat sketch.
4. Explain why grain boundaries are considered as high energy regions?
5. Figure 1 shows the structure of an ideal hexagonally close packed crystal. Derive the ratio "c/a", where 'c'= height of crystal and 'a'= base edge length.

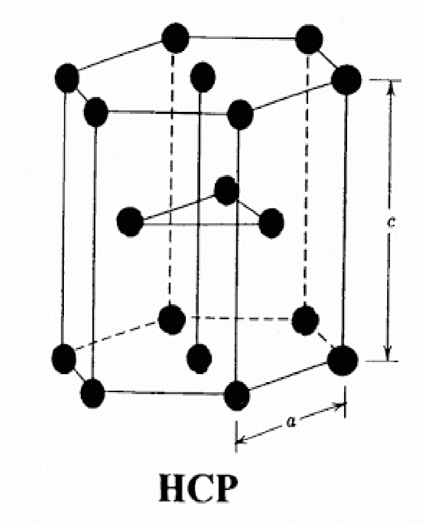

Figure 1: HCP Crystal Structure

Part B

(4 Q x 4 M = 16 Marks)

6. Draw (110) and (111) planes in the same cubic unit cell. Determine the Miller Indices of the direction that is common to both these planes.
7. Derive the following expression for Bragg's law with the help of a neat diagram.

$$n\lambda = 2d \sin\theta \text{ (Bragg's law)}$$

8. With a neat sketch explain the phenomenon of twinning and state the conditions which favor the formation of twin defects.

9. Determine the miller indices for the plane and the direction depicted in the cubic unit cell in Figure 2. Write the steps involved in finding the same.

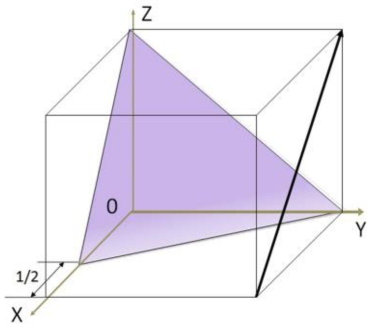

Figure 2: Cubic unit cell

Part C

(2Q x 7 M = 14 Marks)

10. (2 + 5)

(a) State Fick's first law for steady state diffusion along with the mathematical expression for the same, outlining all the terms involved in the expression.

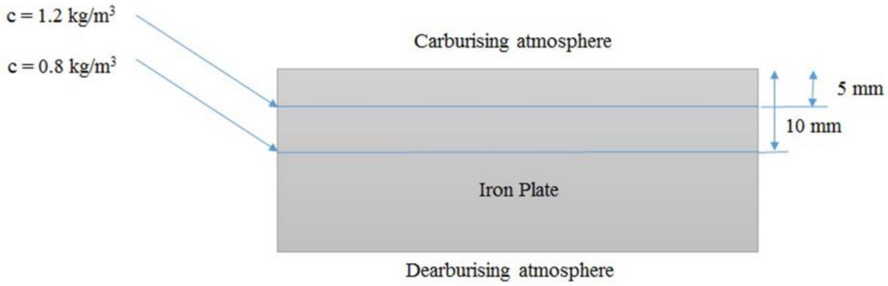

Figure 3: HCP Crystal Structure

(b) An iron plate is exposed to a carburising atmosphere on one side and a decarburising atmosphere on the other side in order to maintain steady state of diffusion as shown in Figure 3. Calculate the diffusion flux of carbon through the plate, if the concentration of carbon at a depth of 5mm and 10mm in the plate are 1.2 Kg/m^3 and 0.8 Kg/m^3. Assume a diffusion coefficient of 3 x 10^{-11} m^2/s at this temperature in Kg/sec.

11. Calculate the following for Iron crystal having BCC crystal structure with suitable figures

(3 + 3 + 1)

(i) The ratio of lattice parameter (a) and atomic radius (r).

(ii) The atomic packing fraction.

(iii) Determine the effective number of iron atoms in each unit cell.