B. MECHANICAL (EVENING) 3RD YEAR 1ST SEM, SUPPLE EXAMINATION, 2017

MATERIALS & METALLOGRAPHY (OLD)

Time: 3 Hours   Full marks: 100

Answer any five questions.

Answer should be brief and to the point.

1. (a) Define a unit cell of a space lattice.

   (b) What is the co-ordination number for the atoms in H.C.P. crystal structure?

   (c) Magnesium at 20°C is H.C.P. The height 'C' of its unit cell is 0.52105 nm and its C/a ratio is 1.623. Calculate its lattice constant.

   (d) Calculate the density of α- iron from the following data:

   Atomic radius of α − iron = 1.24 A°

   Atomic weight = 55.84 gm/c.c.

   (e) Find the number of atoms/cm² on (110) plane of lead:

   Given inter atomic distance = 3.499 A°

   3+2+5+5+5 = 20

2. (a) Draw in unit cubes the crystal planes which have the following Miller Indices :

   $(1\,1\,0\,)$, $(1\,\bar{2}\,0)$, $(1\,2\,\bar{2})$, $(\bar{3}\,1\,2)$.

   (b) Explain with neat sketches the difference between Edge and Screw dislocations.

   (c) Explain the effect of recovery, recrystallisation and grain growth on the hardness, yield strength and ductility change typically for a metal when it is cold worked.

   6+7+7 = 20

3. (a) Draw an iron-iron carbide equilibrium phase diagram according to scale and label it.

   (b) In a heat treatment , steel containing 0.25 wt% C- steel is cooled from austenitic region to room temperature.

   (i) Determine the percentage of proeutectoid ferrite and pearlite formed.

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(ii) Calculate the amount of ferrite and cementite in the steel after cooling it to room temperature .

10+10 = 20

4. (a) Define a phase in a material.

How many degrees of freedom at the triple point?

(b) What is an alloy?

(c) Melting point of Ag = 961°C

Melting point of Cu = 1083°C

Eutectic temperature = 780°C

Eutectic composition = 28.1 % Cu

Maximum solubility of 'Cu' in 'Ag' at 780°C = 8.8% 'Cu'

Maximum solubility of 'Ag' in 'Cu' at 780°C = 7.9% 'Ag'

The solubility of 'Cu' in 'Ag' and 'Ag' in 'Cu' decreases with decreasing temperature and are around 2% at room temperature.

Taking all the liquids, solids and solvus lines are straight – Draw the Ag-Cu phase diagram according to scale.

(d) From the above diagram calculate:

If 750 gm of an 80 wt % Ag- 20 wt % Cu alloy is slowly cooled from 1000°C to just below 780°C.

(i) How many grams of liquid & proeutectic 'β' are present at 780°C + ΔT ?

(ii) How many grams of 'α' are present in the eutectic structure at 780°C – Δ T?

(iii) How many grams of 'β' are present in the eutectic structure at 780°C – Δ T?

3+2+8+7 = 20

5. (a) Describe the factors which controls graphitization in cast iron?

(b) What is Mar tempering?

(c) How malleable cast iron is produced?

Write down the uses of gray C.I. and white cast iron.

5+5+10 = 20

6. (a) What is ordered solid solution ?

(b) Why does slip in metal usually take place on the denser-packed planes?

(c) Write a short note on Metal Ingot Structure.

(d) How is ductility of a material normally effected by cold working?

4+6+5+5 = 20

7. (a) Give the use and properties of Gray C.I. and nodular cast iron.

(b) Explain briefly the following heat treatment processes:

(i) Normalizing (ii) Mar tempering (iii) Homogenized annealing

(c) What is Hume-Rothery rule? What is an alloy? Give examples

5+10+5 = 20

8. Write short notes on any four:

(i) Cold working and hot working

(ii) Crystal defects

(iii) Critical quench rate

(iv) Recovery, Recrystallisation and grain growth

(v) Slip and twinning

(vi) Atomic Packing Factor

5×4 = 20