B.E Metallurgical Engineering
Second Year, Second Semester Supplementary Examination 2022
Subject: Materials Science

Time: Three hours   **Full Marks: 100**

(Answer any five questions from the following taking at least two from each group)

GROUP – A

1 (a) What is a crystal and how is it different from a lattice? Write in tabular form all the Bravais lattices and the corresponding parameters associated with each of the Bravais lattices.   3+2+10 = 15

(b) What is the difference between single crystal and polycrystal? In which case anisotropic behaviour is observed and why?   5

2. (a) What is Diamond? What is the difference between diamond and Graphite? What makes graphite to behave as a very good lubricant? Find the effective number of atoms per unit cell in diamond?

4 + 3 + 3 +5 =15

(b) Write a short note on 'metallic bond."   5

3. (a) Write down the conditions for formation of extensive solid solution. What is supperlattice? Give one example of superlattice and its crystal structure.   4 + 2 + 2 = 8

(b) What is meant by terminal solid solution and solvus curve?   2 + 2 = 4

(c) What is meant by Coordination number? Find the coordination number in FCC structure.   2 + 3 = 5

(d) What is Wiess Zone law?   3

4. (a) What is the difference between a solution and a mixture? Give one example of binary metallurgical systems containing single phase and two phases in each cases at room temperature and name the phase(s).

4 + 2 + 2 = 8

(b) Define Phase and "degree of freedom." Give an example of binary system where three phases including one liquid phase remain in equilibrium and find the "degree of freedom" for existence of such equilibrium.

2 + 2 + 2 +3 = 9

(c) Give an example of solid-state invariant reaction.   **3**

5 (a) Neatly draw a binary isomorphous phase diagram. What is the amount of phase(s) at room temperature in the drawn binary isomorphous system for 80-20 and 60-40 compositions?   3 + 3 = 6

(b) What is ferrite? Find the packing density of ferrite.   2 + 4 = 6

(c) What do you understand by studying a phase diagram? Neatly draw the Fe-C phase diagram.   2 + 6 = 8

Date: 20.06.2023

Pravash Chandra Chakraborti
(Full Name and Signature of the Paper Setter)

GROUP – B

6. (a) What is a matter wave? Find a relationship for wavelength of matter waves. $2 + 4 = 6$

(b) Derive the time-dependent Schrodinger's Equation in one-dimension.   10

(c) In case of wave mechanics why do we need to consider probability density instead of simple probability? 4

7. (a) After deriving all the necessary relationships to show that energy is quantized when a particle is confined in a box with rigid walls and present energy levels, wave functions and probability densities up to four quantum states. $6 + 9 = 15$

(b). A particle limited to the X-axis has the wave function $\psi = ax$ between $x = 0$ and $x = 1$; $\psi = 0$ elsewhere. Find the probability that the particle can be found between $x = 0.45$ and $x = 0.55$.   **5**

8. (a) What is the electric field of a material when the current is equal to 25A, the resistance is measured to be 78Ω, the current density equals 24A/m2, and the length the current flows is 100m?   5

(b) According to Drude model find the relationship for thermal Conductivity in metals under conductive heat transfer condition.   9

(c) Elaborate the concept of Fermi-Dirac Statistics and Fermi energy in metals.   6

9 (a) Discuss the success and limitation of Drude model.   6

(b) A metallic wire has a resistivity of 1.42x10-8 Om. For an electric field 0.14V/m, find the average drift velocity of electron.   6

(c) Explain the difference among metals, insulators and semiconductors in terms of "Band theory."   8

Date: 20.06.2023

Pravash Chandra Chakraborti
(Full Name and Signature of the Paper Setter)