Kafrelsheikh University	Department: Production Engineering & Mechanical Design Total marks: 75 Marks	Faculty Engineering

Course Title: Metallurgy
Course Code: MPD1104
Year: 1st Year Mechanical Engineer

Final Exam

Date: 15-1- 2020.
Allowed time: 3 hrs.
No. of pages: 2

Q1. State which of the following statements is true and which is false: **(15 marks)**

1. Nucleation starts just under the liquids line of a phase diagram
2. The aging temperature should be above solidus and below solvus temperatures
3. Polymorphism is the same compound occurring in more than one crystal structure
4. Nucleation on impurity surfaces is known as heterogeneous nucleation.
5. Imperfections not affect mechanical properties, chemical properties and electrical properties.
6. Vacancy is formed due to a missing atom.
7. Segregation "coring" is the non-uniform composition produced by non-equilibrium solidification.

Q2. Put a line under the correct answer: **(10 marks)**

1. Some characteristics of metals are: (Good conductors of heat- Good conductors of electricity- Are ductile/malleable - High tensile strength- Insoluble in water - All of the previous)
2. APF for a simple cubic structure equal to (0.52 – 0.68 – 0.74 – None of the previous).
3. Columnar grains have the following properties: (Long thin and coarse - Grow predominantly in one direction - Formed at the sites of slow cooling - steep temperature gradient - All of the previous).
4. Alloys can be generally classified into two main Types: (Single and multiple phases' alloys - Substitutional and interstitial solid solution - None of the previous).
5. The eutectic microstructure are (dendrite– lamellar - All of the previous - None of the previous).

Q3. **(15 marks)**

1. For FCC unit cell if we can put one atom of the same diameter of atoms in FCC in the position (½, ½, ½), If not. What the distance by which will the face center atoms to be moved.

2. Pure iron undergoes an allotropic transformation at 912 °C. The BCC form is stable at temperatures below 912 °C, whereas the FCC form is stable above 912 °C. Calculate percentage volume change during the transformation BCC→ FCC, if, at 912 °C, a=3.63A° for FCC and a=2.93 A° for BCC.

3. Determine the Miller indices of the cubic crystal plane which intersects the following position coordinates: **(1,0,0)**; **(1/2,0,1/2)**; **(0,1/4,1/2)**.

Q_4. **(20 marks)**

1. Two metals A and B have melting points of 960°C and 800°C respectively. The metals are completely soluble in one another in the liquid state, but only partially soluble in the solid state. The two branches of the liquidus intersect at 500°C at a point corresponding to 60% B. At this temperature, the two solid solutions contain 20% B and 85% B respectively, and at 0°C they contain 5% B and 95% B. Draw and label the thermal equilibrium diagram for this series of alloys.

2. Describe the changes taking place when:

   (a) An alloy containing 10% B is slowly cooled from 1000°C to room temperature

   (b) An alloy containing 70% B is slowly cooled from 700°C to room temperature

3. Use a neat sketch to indentify each cast iron types by the microscopic examination?

Q_5. **(15 marks)**

1. Explain the aim and technique of full annealing heat treatment of steel? What are some of its purposes?

2. Distinguish between the following three types of plain-carbon steels.
   I) Eutectoid ii) hypo - eutectoid iii) hyper – eutectoid

3. 0.35% C hypo cutectoid plain carbon steel is slowly cooled from about 950°C to a temperature just slightly above 723°C.

   a. Calculate the weight percent austenite and weight percent proeutectoid ferrite in the steel.

   b. Sketch the microstructure of this alloy above and below the eutectoid temperature.

   c. What will be the structure of this alloy if it is rapidly quenched? And what will be the effect on the mechanical properties?

With my best wishes

Dr. Eng. Maher . R. Elsadaty