Student name:_____ Student ID no.:_____

國立高雄應用科技大學 機械與精密工程研究所博士班
105 學年度第一學期 博士班資格考(Qualifying Exam)

考試科目：Engineering Materials **(Part-A)**

本考科試題共有兩部分(Part-A and Part-B)，考生於每部份試題(四題)中至多選三題作答，兩部分總合只能選答五題，每題 20 分，共 100 分（考試時間為 100 分鐘）

This Qualifying exam includes two parts (Part-A and Part-B). Student should choose **two to three** questions in each part (four questions), and the total question to answer for the sum of two parts should **not excess five questions**. Each question 20 points, a total of 100 points (exam time 100 minutes)

☐ **Click if you choose this question to answer**

1. For an FCC unit cell, (*a*) how many atoms are there inside the unit cell, (*b*) what is the coordination number for the atoms, (*c*) what is the relationship between the length of the side *a* of the FCC unit cell and the radius of its atoms, and (*d*) what is the atomic packing factor?

☐ **Click if you choose this question to answer**

2. (1) Describe and illustrate the following imperfections that can exist in crystal lattices: (*a*) Frenkel imperfection, (*b*) Schottky imperfection.

(2) Describe and illustrate the following planar defects: (*a*) twins, (*b*) stacking faults.

☐ **Click if you choose this question to answer**

3. The diffusivity of copper atoms in the aluminum lattice is 7.50×10^{-13} m^2/s at 600℃ and 2.50×10^{-15} m^2/s at 400℃. Calculate the activation energy for this case in this temperature range. $R = 8.314$ J/(mol · K).

☐ **Click if you choose this question to answer**

4. A sample of BCC metal was placed in an X-ray diffractometer using X-rays with a wavelength of $\lambda = 0.1541$ nm. Diffraction from the {221} planes was obtained at $2\theta = 88.838°$. Calculate a value for the lattice constant *a* for this BCC elemental metal. (Assume first-order diffraction, $n = 1$.)

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Engineering Materials **(Part-B)**

☐ **Click if you choose this question to answer**

1.Calculate the resolved shear stress on the (111)[0$\underline{1}$1] slip system of a unit cell in an FCC nickel single crystal if a stress of 15 Mpa is applied in the [001] direction of a unit cell.

☐ **Click if you choose this question to answer**

2. A structural plate component of an engineering design must support 207 Mpa in tension. If aluminum alloy 2024-T851(K_{IC} = 26.4 Mpa・$m^{1/2}$) is used for this application , what is the largest internal flaw size that this material can support?(Use Y = 1).

☐ **Click if you choose this question to answer**

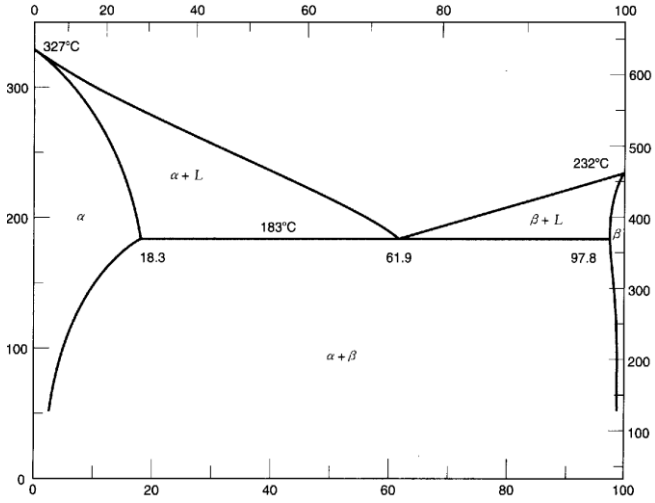
3. A alloy of 30 wt%Pb-70 wt% Sn is slowly cooled from 250^{o}C to 27^{o}C(see the figure).

(a)what is the composition of the first solid to form?

(b)What are the amounts and compositions of each phase that is present at 183^{o}C + ΔT?

(c)What is the amounts and compositions of each phase that is present at 183^{o}C - ΔT?

(d)What is the amounts of each phase that is present at room temperature?



☐ **Click if you choose this question to answer**

4. (a)What is an isothermal transformation in the solid state?

(b)Draw an isothermal transformation diagram for a plain-carbon eutectoid steel and indicate the various decomposition products on it. How can such a diagram be constructed by a series of experiments?