Student name:_____ Student ID no.:_____

國立高雄應用科技大學 機械工程系博士班
105 學年度第二學期 博士班資格考(Qualifying Exam)

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)

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

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

1. X-rays of an unknown wavelength are diffracted by a gold sample. The 2θ angle was 64.582° for (220) planes. What is the wavelength of the X-rays used? (The lattice constants of gold is 0.40788 nm; assume the first-order diffraction, n=1)

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

2. Calculate the number of vacancy per cubic meter in gold at 900 ℃, the energy for vacancy formation is 0.98 eV/atom, the density and atomic weight for Au are 19.32 g/cm^3 and 196.9 g/mol, respectively

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

3. An alloy metal consists of two components, metal A and metal B. If the density of A and B are 4.25 and 6.35 g/cm^3, and the atomic weight of A and B are 61.5 and 125.7g/mol, respectively. Assuming the unit cell of the alloy is a simple cubic with its dimension shown in Fig. 1 (a = 0.395 nm). What is the atomic packing type for this alloy metal, FCC or BCC?

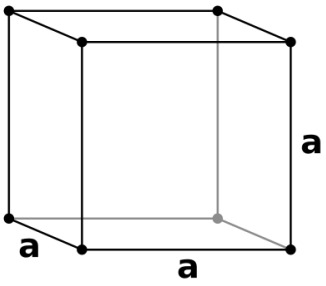

Fig. 1

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

4. A copper-zinc alloy (85wt% Cu-10wt% zinc) is coupled with pure copper (interfaced). The diffusion couple is then heated to a temperature of 1000°C. (*a*) How long will it take for the concentration of zinc to reach 0.2%, 2.5 mm below the interface? (*b*) How much will the zinc concentration at the same point be in twice the time calculated in part a?

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

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

1.What are the principle slip planes and slip directions for FCC, BCC and HCP metals.

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

2. Describe the four basic structural changes that take place when a homogeneous ductile metal is caused to fail by fatigue under cyclic stresses.

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

3. Derive the lever rule for the amount in weight percent of each phase in two-phase regions of a binary phase diagram. Use a phase diagram in which two elements are completely soluble in each other.

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

4. (a) What is the full-annealing heat treatment for a plain-carbon steel. (b) What types of microstructures are produced by full annealing (i) a eutectoid steel and (ii) a hypoeutectoid steel?

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考試科目：Engineering Mathematics (Part-A)

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

1. Please solve the following differential equation:

$$y'' + 2y' - 8y = 2e^{-2x} - e^{-x}$$

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

2. Use Laplace transform to solve the given initial-value problem:

$$y'' + 4y' + 3y = 1 - U(t-2) - U(t-4) + U(t-6),\ y(0) = 0,\ y'(0) = 0$$

in which U stands for unit step function.

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

3. Use the indicated change of variable to find the general solution of the given differential equation on the interval (0, ∞),

$$x^2y'' + (\alpha^2x^2 - v^2 + \tfrac{1}{4})y = 0;\ \ y = \sqrt{x}u(x)$$

Using Bessel's equation of order v: $x^2y'' + xy' + (x^2 - v^2)y = 0$

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

4. Please use Laplace transform to solve the given system of differential equations:

$$\frac{dx}{dt} - 4x + \frac{d^3y}{dt^3} = 6\sin t$$
$$\frac{dx}{dt} + 2x - 2\frac{d^3y}{dt^3} = 0$$
$$x(0) = 0,\ y(0) = 0$$
$$y'(0) = 0,\ y''(0) = 0$$

考試科目：Engineering Mathematics (Part-B)

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

1. Define matrix $\mathbf{A} = \begin{pmatrix} -2 & 4 \\ -1 & 3 \end{pmatrix}$. Evaluate (a) the eigenvalues of **A** and (b) $\mathbf{A}^m$, m is a positive integer.

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

2. Find the line integral:

$\int_C G(x,y)ds$, $G(x,y) = x^3 + 2xy^2 + 2x$ $\{x = 2t, y = t^2, 0 \le t \le 1\}$.

(Hint: $2t^2 + t^4 + 1 = (1+t^2)^2$, $d(1+t^2) = 2tdt$)

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

3. Expand $f(x) = \begin{cases} 0, & \{-\pi < x < 0\} \\ \pi - x, & \{0 \le x < \pi\} \end{cases}$ in a Fourier series as

$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}(a_n \cos nx + b_n \sin nx)$. Find a_0 and a_n.

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

4. Use separation of variables to find product solution for the following partial differential equation $\frac{\partial u(x,y)}{\partial x} + 3\frac{\partial u(x,y)}{\partial y} = 0$