國立高雄應用科技大學機械系機械與精密工程組博士班
102 學年度第一學期博士班資格考(Qualifying Exam)

考試科目：Engineering Mathematics(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）
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☑ **Click if you choose this question to answer**

1.. $(x+1)\dfrac{dy}{dx} + y = \ln x, \; y(1) = 10$

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

2. Please find the Laplace transform of the given periodic function:
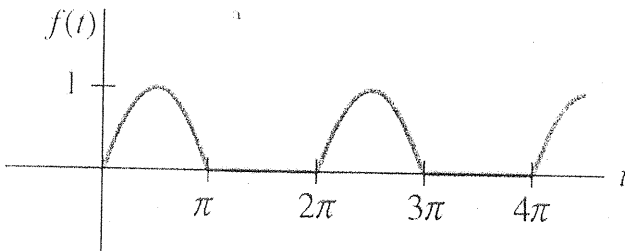
Half-wave rectification of sin t

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

3. $y'' + y = f(t), \; y(0) = 0, \; y'(0) = 1$, where

$$f(t) = \begin{cases} 0, & 0 \leqslant t < \pi \\ 1, & \pi \leq t < 2\pi \\ 0, & t \geq 2\pi \end{cases}$$

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

4. Please use Bessel functions of the first kind $J_v(x)$ and modified Bessel function of the first kind

$I_v(x) = i^{-v} J_v(ix)$, to show that $I_{\frac{1}{2}} = \sqrt{\dfrac{2}{\pi x}} \sinh x$

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102 學年度第一學期 博士班資格考(Qualifying Exam)

考試科目： __Engineering Mathematics (Part-B)__

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）

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

1. show that the helix $[a\cos t, a\sin t, ct]$ can be represented by

$[a\cos(s/K), a\sin(s/K), cs/K]$, where $K = \sqrt{a^2 + c^2}$ and s is the arc length. Show

that it has constant curvature $\kappa = a/K^2$ and torsion $\tau = c/K^2$.

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

2. Calculate the following Fourier sine and cosine transform:

   a. Find the cosine transform $\hat{f}_c(w)$ of $f(x)=1$ if $0 < x < 1$, $f(x)=-1$ if $1 < x < 2$,

     $f(x)=0$ if $x > 2$。

   b. Find the sine transform $\hat{f}_s(w)$ for $f(x)=x^2$ if $0 < x < 1$, $f(x)=0$ if $x > 1$。

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

3. **Verity that the given function is a solution of PDE.**

   a. $\dfrac{\partial^2 u}{\partial t^2} = c^2 \dfrac{\partial^2 u}{\partial x^2}, u = \cos 4t \sin 2x$; b. $\dfrac{\partial u}{\partial t} = c^2 \dfrac{\partial^2 u}{\partial x^2}, u = e^{-\omega^2 c^2 t} \cos \omega x$;

c. $\dfrac{\partial^2 u}{\partial x^2} + \dfrac{\partial^2 u}{\partial y^2} = 0, u = arctan(y/x)$

☑ **Click if you choose this question to answer.**

4. The evaluation of line integrals in space is practically the same as it is in the plane.

To see this, find the value of $\displaystyle\int_C \mathbf{F}(\mathbf{r}) \cdot d\mathbf{r} = \int_a^b \mathbf{F}(\mathbf{r}(t)) \cdot \mathbf{r}'(t)dt$ when $\mathbf{F}(\mathbf{r}) = [z, x, y] =$

$z\mathbf{i} + x\mathbf{j} + y\mathbf{k}$ and C is the helix (Fig. 4) $\mathbf{r}(t) = [\cos t, \sin t, 3t] = \cos t\ \mathbf{i} + \sin t\ \mathbf{j} + 3t\mathbf{k}$
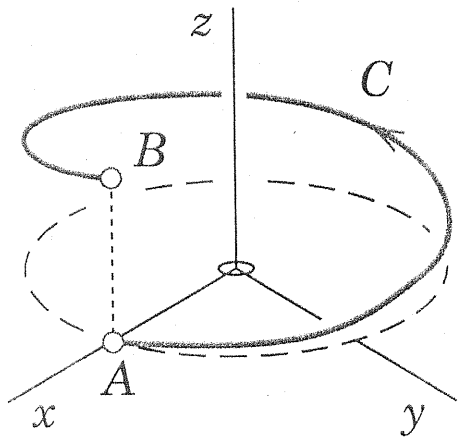$(0 \leq t \leq 2\pi)$.

Fig.4

國立高雄應用科技大學 機械與精密工程研究所博士班

102 學年度第 1 學期 博士班資格考(Qualifying Exam)

考試科目： Precision Manufacturing (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）

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

1. Refer to TABLE 1. Please explain the meaning for the production terms for manufacturing systems, and make an example for each term. (M1~M5) are meaning for each term and (E1~E5) are examples for each term.

TABLE 1. Production Terms for Manufacturing Production Systems

Term	Meaning	Examples
Production system The enterprise	(M1)	(E1)
Manufacturing system (sequence of operations, collection of processes)	(M2)	(E2)
Machine or machine tool or manufacturing process	(M3)	(E3)
Job (sometimes called a station; a collection of tasks)	(M4)	(E4)
Operation (sometimes called a process)	(M5)	(E5)

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

2. Please compare *Brinell* hardness tester and *Vickers* hardness tester respect to the following issues: indenter geometry, hardness value, advantage, and other.

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

3. (a) Please describe the way to obtain the true stress-true strain curve from tensile test. (b) Please depict the difference between true stress-true strain and engineering stress-engineering strain.

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

4. (a) What is metal forming? (b) How to distinguish hot working to cold working?

考試科目： __Precision Manufacturing (Part-B)__

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. (a)、What is a printed circuit board (PCB)? (b)、What three elements does a PCB consist of? (c)、Draw the typical thermal profile used for the PCB (reflow).

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

2. (a)、What is the joining process? (b)、What is the welding process? (c)、What is purpose of pre- and post-heating in welding operations, and (d)、why the residual stresses exist in welded parts?
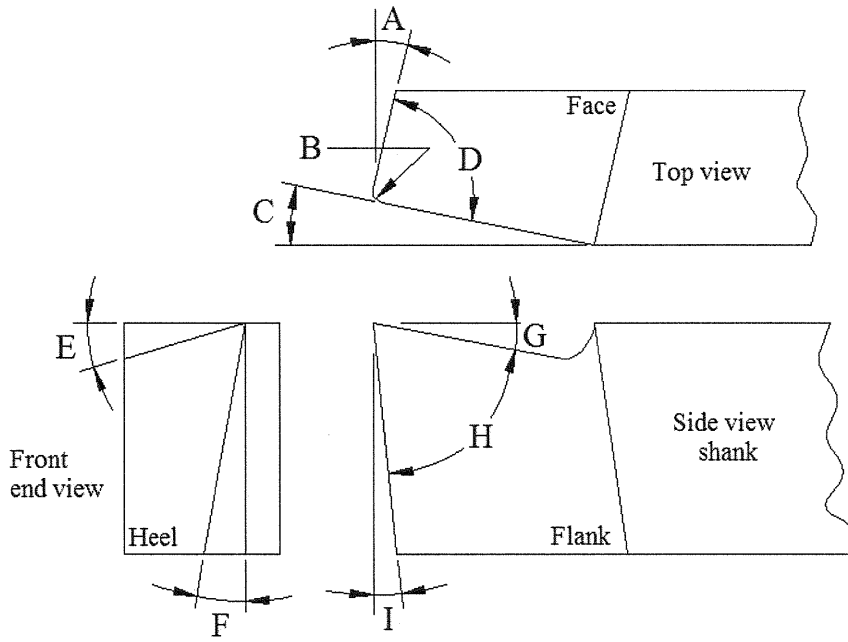
☑ **Click if you choose this question to answer**

3. (a)、What are the differences between the tube and pipe? (b)、What are their manufacture processes?

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

4. A single point tool is shown. Write A~I for the tool nomenclature, please.

4. A single point tool is shown. Write A~I for the tool nomenclature, please.

A

Face

Top view

B

D

C

E

G

Front
end view

H

Side view
shank

Heel

Flank

F

I

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考試科目：<u>Engineering Materials (Part-A)</u>

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）

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

1.(a)Calculate the volume of the zinc crystal structure unit cell by using the following data pure zinc has HCP crystal structure with lattice constants a = 0.2665 nm and c = 0.4974 nm.
(b)Find the volume of the larger cell.

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

2. A sample of BCC iron was placed in an X-ray diffractometer using incoming X-rays with a wavelength λ = 0.1541 nm. Diffraction from the {110} planes was obtained at 2θ = 44.704°. calculate a value for the lattice constant a of BCC iron.(Assume first-order diffraction with n = 1.)

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

3. (a)Distinguish between homogeneous and heterogeneous nucleation for the solidification of a pure metal.
(b)During solidification, how does the degree of undercooling affect the critical nucleus size? Assume homogeneous nucleation.

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

4. (a)What is the Kirkendall effect in solid state diffusion?
(b)Write the equations for Fick's first and second law of diffusion in solid, and define each of the terms.

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考試科目：<u>Engineering Materials</u> **(Part-B)**

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

1. If it takes 115 hour to 50 percent recrystallize an 1100-H18 alumnium alloy sheet at 250°C and 10 hour at 285°C, calculate the activation energy in kilojoules per mole for this process. Assume an Arrhenius-type rate beheavior.
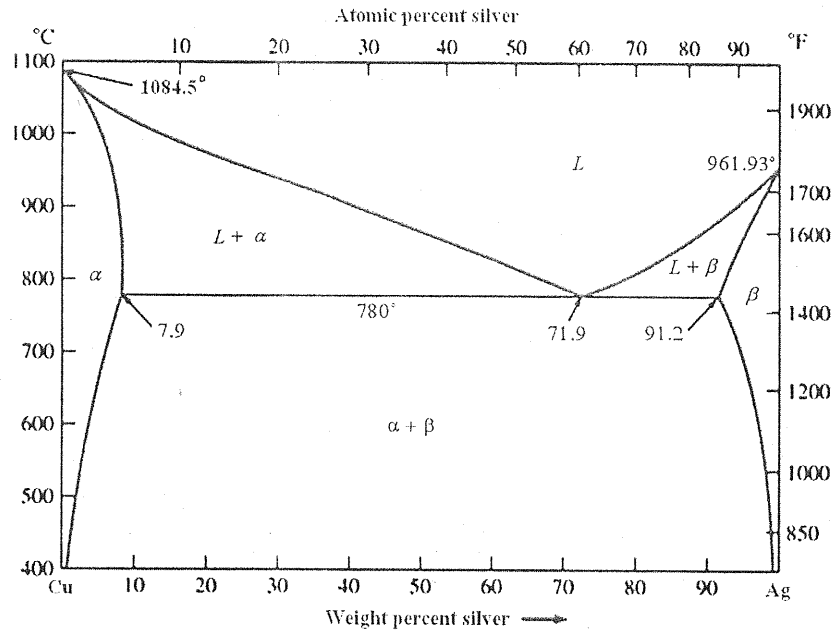
☐ **Click if you choose this question to answer**

2. A large flat plate is subjected to constant-amplitude uniaxial cyclic tensile and compressive stresses of 120 and 35 MPa, respectively. If before testing the largest surface crack is 1.00 mm and the plain-strain fracture toughness of the plate is $35 \text{ MPa}\sqrt{m}$, estimate the fatigue life of the plate in cycles to failure. For the plate, $m = 3.5$ and $A = 5.0 \times 10^{-12}$ in MPa and meter units. Assume $Y = 1.3$. (10 points)

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

3. If 500 g of a 40 wt % Ag–60 wt % Cu alloy is slowly cooled from 1000°C to just below 780°C (see Fig. 1):
   (a) How many grams of liquid and proeutectic alpha are present at 850°C?
   (b) How many grams of liquid and proeutectic alpha are present at 780°C $+\Delta T$?
   (c) How many grams of alpha are present in the eutectic structure at 780°C $-\Delta T$?
   (d) How many grams of beta are present in the eutectic structure at 780°C $-\Delta T$?

Atomic percent silver / Weight percent silver — Cu-Ag phase diagram

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

4. (a) Define an Fe-C martensite.
   (b) Describe the following types of Fe-C martensites that occur in plain-carbon steels:
       (*i*) lath martensite, (*ii*) plate martensite.
   (c) Describe some of the characteristics of the Fe-C martensite transformation that occurs in plain-carbon steels.
   (d) What causes the tetragonality to develop in the BCC iron lattice when the carbon content of Fe-C martensites exceeds about 0.2 percent?
   (e) What causes the high hardness and strength to be developed in Fe-C martensites of plain-carbon steels when their carbon content is high?