

Student name: _____ Student ID no.: _____

國立高雄應用科技大學 機械系機械與精密工程組博士班
104 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）

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Click if you choose this question to answer

1. Define the following terms: (a) ionization energy (b) atomic packing factor (c) activation energy (d) homogeneous nucleation (e) Arrhenius rate equation.

Click if you choose this question to answer

2. Copper has an FCC crystal structure and an atomic radius of 0.1278 nm.

Assuming the atoms to be hard spheres that touch each other along the face diagonals of FCC unit cell. Calculate the theoretical value for the density of copper in mega-gram per cubic meter. The atomic mass of copper is 63.54 g/mol..

Click if you choose this question to answer

3. An X-ray diffractometer recorder chart for an element that has either the BCC or the FCC crystal structure showed diffraction peaks at the following 2θ angles : 36.191° , 51.974° , 64.982° , and 76.663° . using incoming X-rays with a wavelength $\lambda = 0.1541$ nm

- (a) Determine the crystal structure of the element.
- (b) Determine the lattice constant of the element.

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：Engineering Materials (Part-B)

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Click if you choose this question to answer

1. A 20-cm-long rod with a diameter of 0.250 cm is loaded with a 5000 N weight. If the diameter decreases to 0.210 cm, determine (a) the engineering stress and strain at this load and (b) the true stress and strain at this load

Click if you choose this question to answer

2. Determine the critical crack length for a through crack in a thick plate of 7150-T651 aluminum alloy that is in uniaxial tension. For this alloy $K_{IC} = 25.5 \text{ MPa} \sqrt{m}$ and $\sigma_f = 400 \text{ MPa}$. Assume $Y = \sqrt{\pi}$.

Click if you choose this question to answer

3. Write equations for the following invariant reactions: eutectic, eutectoid, peritectic, and peritectoid. How many degrees of freedom exist at invariant reaction points in binary phase diagrams?

Click if you choose this question to answer

4. (a) What alloying element and how much of it (weight percent) is necessary to make a stainless steel "stainless"? (b) What type of surface film protects stainless steels? (c) What are the four basic types of stainless steels?

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考試科目：Engineering Mathematics (Part-A)

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Click if you choose this question to answer

1. Solve $x(t)$ and $y(t)$ for the system of linear differential equations: $x' = 4x + 7y$, $y' = x - 2y$.

Click if you choose this question to answer

2. Solve $y(x)$ for $y'' + y = \tan x$. (Hint: $-\int \sin x \tan x dx = \sin x - \ln|\sec x + \tan x|$)

Click if you choose this question to answer

3. Solve $y(t)$ for the differential equation $y'' + y = \delta(t - 4\pi)$, $y(0) = 1$, $y'(0) = 0$. $\delta(t)$ is the Dirac Delta function.

Click if you choose this question to answer

4. The power series solution of the differential equation $y'' + (\cos x)y = 0$ is

$y = \sum_{n=0}^{\infty} c_n x^n = c_0(1 + a_2 x^2 + a_4 x^4 + \dots) + c_1(1 + a_3 x^3 + a_5 x^5 + \dots)$. Solve the values of a_2 , a_3 , a_4 and a_5 .

(Hint: $\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \dots$)

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考試科目： Engineering Mathematics (Part-B)

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Click if you choose this question to answer

1. Please evaluate the given iterated integral by changing to polar coordinates:

$$\int_0^{\sqrt{2}/2} \int_y^{\sqrt{1-y^2}} \frac{y^2}{\sqrt{x^2 + y^2}} dx dy$$

Click if you choose this question to answer

2. The given matrix \mathbf{A} is symmetric. Find an orthogonal matrix \mathbf{P} that diagonalizes \mathbf{A} and the diagonal matrix \mathbf{D} such that $\mathbf{D} = \mathbf{P}^T \mathbf{A} \mathbf{P}$

$$\mathbf{A} = \begin{pmatrix} 9 & 1 & 1 \\ 1 & 9 & 1 \\ 1 & 1 & 9 \end{pmatrix}$$

Click if you choose this question to answer

3. Please find the complex Fourier series of f on the given interval:

$$f(x) = e^{-|x|}, \quad -1 < x < 1$$

Click if you choose this question to answer

4. Please solve the following wave equation subject to the given conditions:

$$a^2 \frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}, \quad 0 < x < L, \quad t > 0$$

$$u(0, t) = 0, \quad u(\pi, t) = 0, \quad t > 0$$

$$u(x, 0) = 0.01 \sin(3\pi x), \quad \left. \frac{\partial u}{\partial t} \right|_{t=0} = 0, \quad 0 < x < \pi$$

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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(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. Based on Fig.1, describe the ten key processes for automobile production in detail.

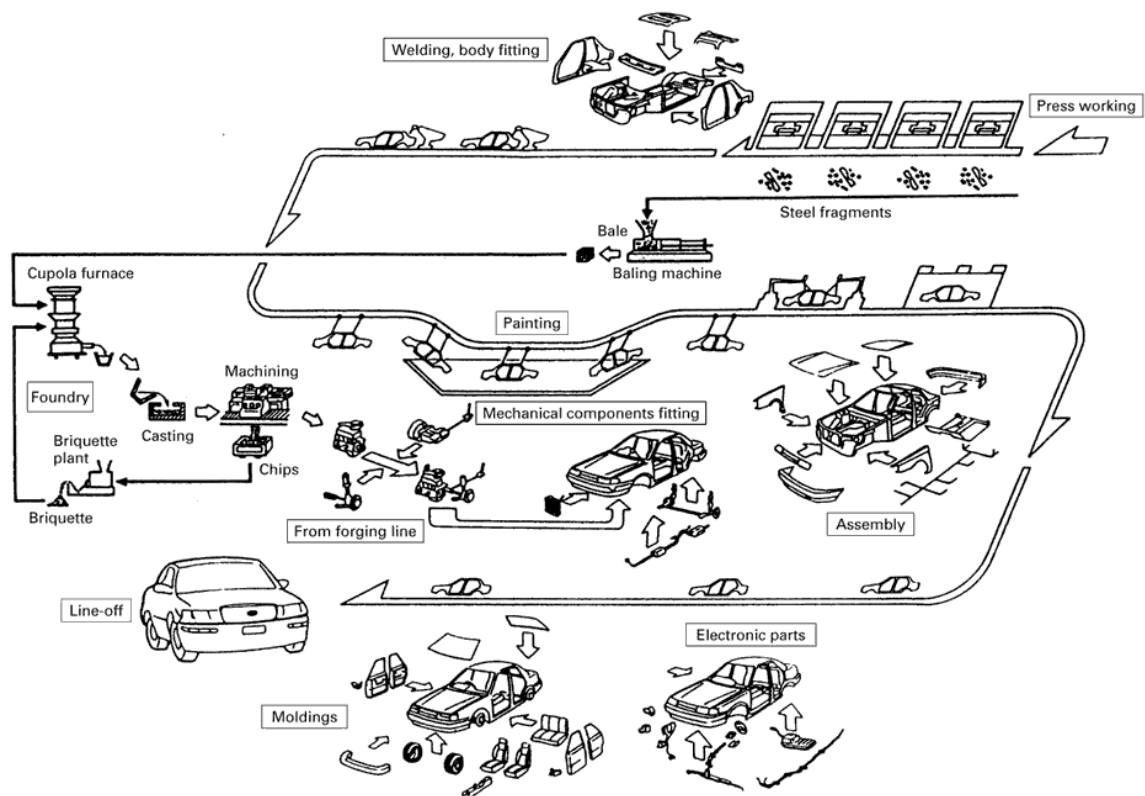


Fig. 1

Click if you choose this question to answer

2. Answer the following definitions in detail with figures, equations and descriptions: (1) true stress; (2) true strain; (3) engineering stress; (4) engineering strain.

Click if you choose this question to answer

3. Chvorinov's rule tells $t_s = B(V/A)^{2.0}$ where t_s is total solidification time, V is volume of casting, A is surface area through which heat is extracted, and B is the mold constant. Assume that the solidification time of riser is 1.5 times of casting, please use the above rule to calculate the dimensions of an effective riser for a casting which is a rectangular plate 2 inch by 4 inch by 6 inch with the dimensions. Assume that the casting and riser are not connected, except through a gate and runner, and that the riser is a cylinder of height/diameter ratio $H/D = 2$. The finished casting is what fraction of the combined weight of the riser and casting?

Click if you choose this question to answer

4. Based on Table.1, explain the independent variables, the dependent variables, and the various means of linking the two for metal forming processes.

<u>Independent variables</u>	<u>Links</u>	<u>Dependent variables</u>
Starting material	-Experience-	Force or power requirements
Starting geometry		Product properties
Tool geometry	-Experiment-	Exit temperature
Lubrication		Surface finish
Starting temperature	-Modeling-	Dimensional precision
Speed of deformation		Material flow details
Amount of deformation		

Table.1

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考試科目：Precision Manufacturing (Part-B)

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1. (a) Explain the factors that influence the flank wear of the cutting tool.
(b) How can the tendency for built-up edge chips formation be reduced?

Click if you choose this question to answer

2. (a) Describe the basic principle of electrochemical machining.
(b) How to reduce the tool wear in the electrical-discharge machining process?

Click if you choose this question to answer

3. (a) What are the purposes of prebaking and postbaking in lithography?
(b) Explain the differences between wet and dry oxidation.

Click if you choose this question to answer

4. (a) Explain the following terms: normal anisotropy; planar anisotropy.
(b) Describe the means to reduce the magnitude of the roll force.