國立虎尾科技大學機械與機電工程研究所博士班資格考試試題

科目名稱：機械製造　　2008/05

班級：_____　學號：_____　姓名：_____　成績：

1. Describe the methods used for producing single-crystal parts. (10%)
2. Explain the difference between open-die and impression-die forging? (10%)
3. Describe briefly the production steps involved in making powder-metallurgy parts. (10%)
4. What are the major requirements for cutting-tool materials? (10%)
5. State whether you would set the height of the tool in a turning operation at the center of the workpiece, a little above it, or a little below it. Explain why. (10%)
6. Explain what is meant by a grinding wheel acting soft or hard. (10%)
7. Why has electrical-discharge machining become so widely used? (10%)
8. Explain what is meant by solid-state welding. (10%)
9. Why are surface roughness design requirements in engineering so broad? (10%)
10. Explain the principle of an air gage. What advantages do they have over other types of gages? (10%)

國立虎尾科技大學　機械與機電工程研究所

97 學年度第 2 學期　博士班資格考 【機械製造】

1. 解釋名詞:

   (a) 刀口積屑(BUE), 5%

   (b) 層加工(Layer manufacturing), 5%

   (c) 延性材料(Ductile), 5%

   (d) 回彈效應(Spring-back effect), 5%

2. 請繪圖說明無縫管件製造的方法(20%)

3. 請說明常溫加工與低溫加工的定義,兩者優缺點的比較(20%)

4. 在非傳統加工中之雷射加工(Laser machining), 請說明其加工的原理與熱影響區(Heat affect zone, HAZ)之影響(20%)

5. 請說明脫模鑄造(investment casting)的原理與優點(20%)

國立虎尾科技大學　機械與機電工程研究所

98 學年度第 1 學期　博士班資格考 【機械製造】

一、解釋名詞：（請寫出中文名詞，並詳細說明其意義、5%）

1-1. Plastic deformation

1-2. Work hardening

1-3. Ultimate tensile strength

1-4. hot working of metal

1-5. Closed-die forging

1-6. Formability

1-7. Spring-back effect

1-8. Heat affected zone (HAZ)

1-9. Build-up edge (BUE)

1-10. Cold extrusion

二、問答題：(除了計算題外，請繪圖並加以文字詳細說明、10%)

2-1. A cylinder with a diameter of 25 mm and height of 75 mm solidifies in three minutes in a sand casting operation. What is the solidification time if the cylinder height is doubled? What is the time if the diameter is doubled? (Assume n=2)

Hint: solidification time $= C\left(\frac{\text{volume}}{\text{surface area}}\right)^n$, where C is a constant.

2-2. What is investment casting process?

2-3. Estimated the force required for punching a 25-mm diameter hole through a 3.2-mm thickness annealed titanium-alloy Ti-6Al-4V sheet at room temperature.

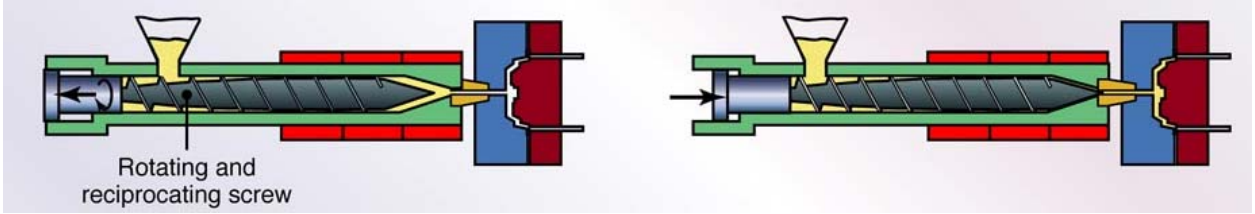
Hint: maximum punch force, $F = 0.7 \times T \times L \times UTS$, where T is thickness, L is total length sheared, and UTS is the ultimate tensile strength.

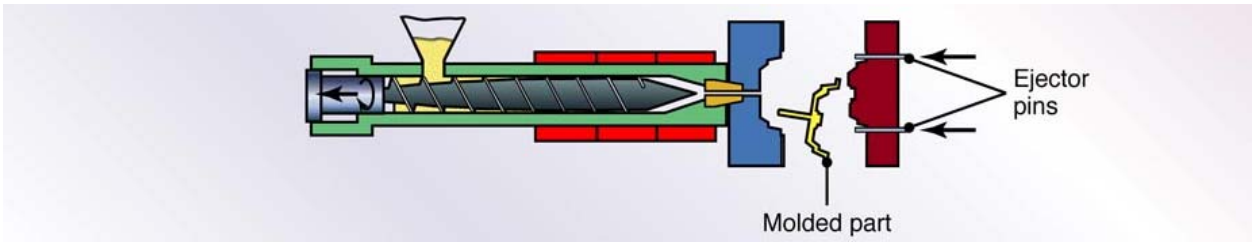
Properties and Typical Applications of Selected Wrought Titanium Alloys at Various Temperatures

Nominal composition (%)	UNS	Condition	Ultimate tensile strength (MPa)	Yield strength (MPa)	Elongation (%)	Reduction of area (%)	Temp. (°C)	Ultiamte tensile strength (MPa)	Yield strength (MPa)
99.5 Ti	R50250	Annealed	330	240	30	55	300	150	95
5 Al, 2.5 Sn	R545200	Annealed	860	810	16	40	300	565	450
6 Al, 4V	R56400	Annealed	1000	925	14	30	300	725	650
		Solution + age	1175	1100	10	20	300	980	900
13 V, 11 Cr, 3 Al	R58010	Solution + age	1275	1210	8	-	425	1100	830

2-4. Illustrate and explain the tube-drawing process.

2-5. Explain the process illustrated below and discuss the influence parameters.




Ejector
pins
Molded part

國立虎尾科技大學　機械與機電工程研究所

99 學年度第 1 學期　博士班資格考 【機械製造】

1. 解釋名詞:

   (a) Nondestructive testing, 5%

   (b) Lever rule, 5%

   (c) Ball milling, 5%

   (d) Disposable patterns casting, 5%

2. 請繪圖說明五軸加工的原理及其優缺點(20%)

3. 請說明複合材料的種類及其製備的方法(20%)

4. 在非傳統加工中之超音波加工(Ultrasonic machining), 請分別說明壓電材料產生壓電效應的原理、壓電效應、逆壓電效應及超音波加工的種類(20%)

5. 請說明微機電系統中LIGA (Lithographic Gavanoforming Abforming 通常簡稱為深刻電鑄模造技術) 的製程步驟(20%)

國立虎尾科技大學　機械與機電工程研究所

100 學年度第 2 學期　博士班資格考 【機械製造】

一、解釋名詞：（請寫出中文名詞，並詳細說明其意義，25%）

1. Tolerance
2. Brittle Fracture
3. Ductility
4. Spring-back effect
5. Mechanical fibering

二、何謂塑性加工？目前業界常用之塑性加工法有哪幾種?請任選兩種加以簡要說明。（15%）

三、一般金屬鑄件固化成形過程中會有收縮的現象，此收縮的現象可分哪三個階段？此三個階段對鑄件會造成何種效應？（15%）

四、請簡要說明一般傳統粉末冶金製程的三個步驟。（15%）

五、何謂 open-die-forging、impression-die forging 及 flashless forging？請繪簡圖說明。（15%）

六、請以砂模鑄造一個啞鈴為例，簡單繪圖說明砂模之主要特徵。（15%）

國立虎尾科技大學 102 學年度第一學期博士班資格考試題

所別：機械與機電工程研究所　　第 1 頁　共 1 頁

科目：機械製造

注意事項：
（1）本試題共有 7 題，合計一百分。
（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。
（3）禁止使用計算機

1. How do the three concepts of ductility, toughness, and impact toughness compare, and from which tests do they result?(15%)
2. Name and explain imperfections in crystals. (15%)
3. Express the relationship between tensile yield strength and grain size. (15%)
4. What are the four basic powder metallurgy operations? (15%)
5. What are unilateral and bilateral tolerancing? (10%)
6. Why do edges need to be prepared in welding? What does edge preparation mean? (15%)
7. What are the factors to be considered during the selection of a pattern material? (15%)

國立虎尾科技大學 103 學年度第一學期博士班資格考試題

所別：動力機械系機械與機電工程博士班　　第 1 頁　共 2 頁

科目：機械製造

注意事項：

（1）本試題共有 4 題，每題 25 分，合計一百分。

（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。

（3）close book

1. Figure 1 indicates some hot tears in castings. Please review each one and offer solutions to avoid them.

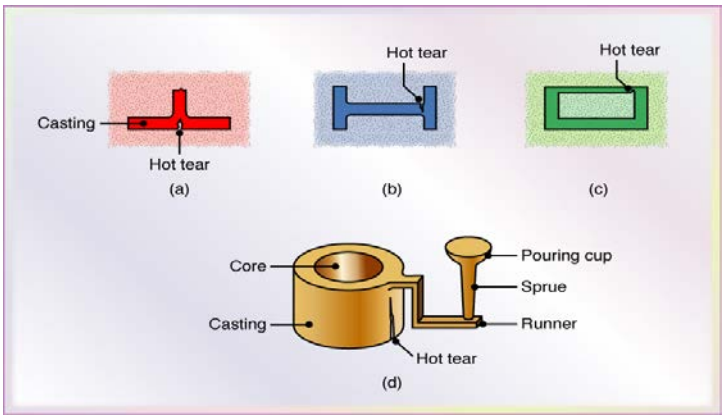


Fig. 1 Hot tears in castings

2. If you need only a few casting parts, which process would you use? Why?

3. Fig. 2 shows a round impression-die forging, made from a cylindrical blank as shown on the left. Please suggest a sequence of intermediate forging steps to make this part and sketch the shape of the dies needed.

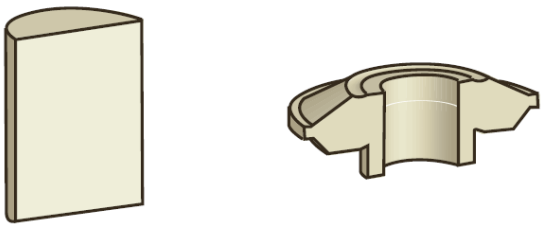


Fig. 2

4. As shown in Fig.3, how would you reduce the surface roughness ?

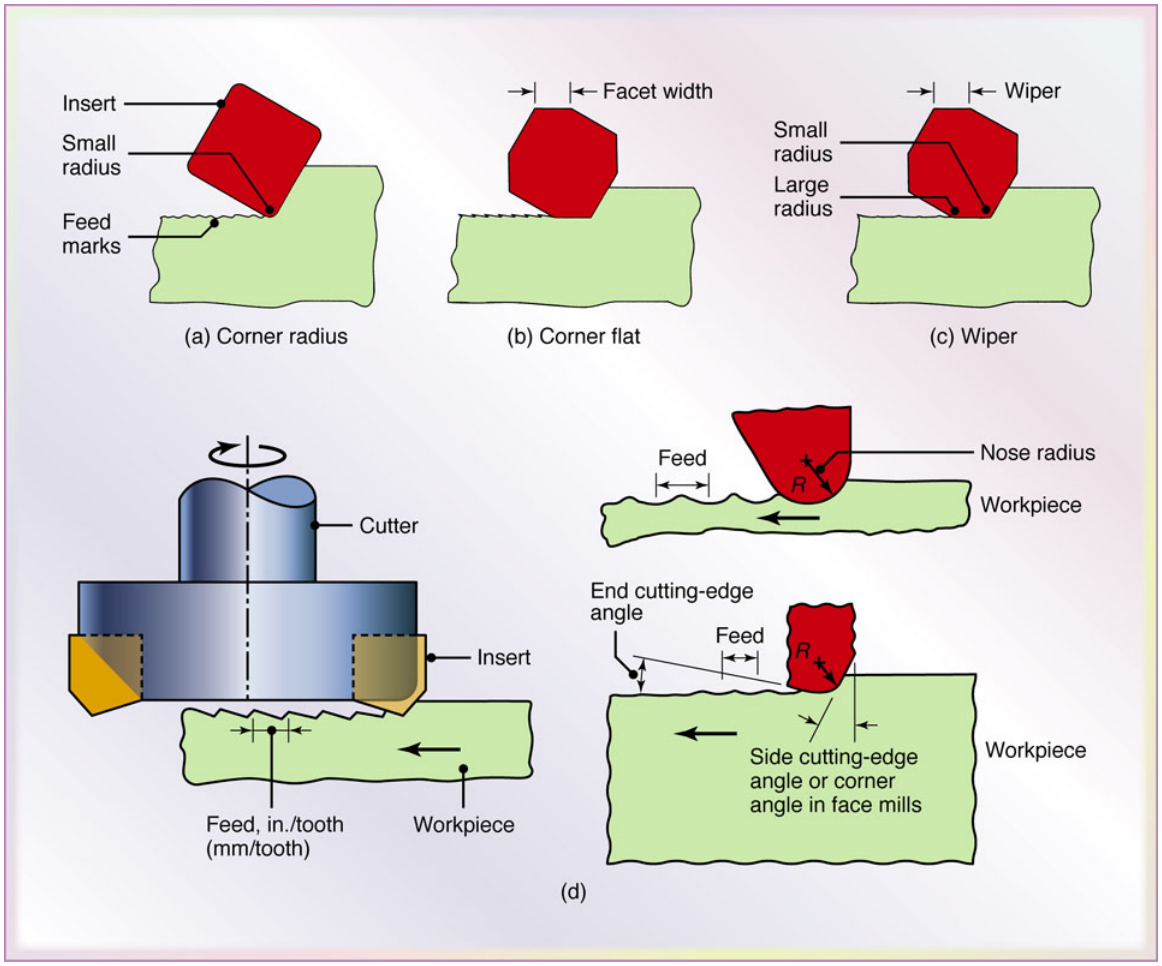


Fig. 3

附件一

【機械製造】

Examination scope

1. Fundamentals of metal casting

2. Metal-casting processes and equipment

3. Metal-forging processes and equipment

4. Machining processes

5. Gear manufacturing

Reference books

1. Manufacturing Engineering & Technology. Manufacturing Engineering and Technology, 7th ed. S. Kalpakjian and S.R. Schmid.

國立虎尾科技大學 103 學年度第二學期博士班資格考試題

所別：動力機械系機械與機電工程博士班　　第 1 頁　共 1 頁

科目：機械製造

注意事項：

（1）本試題共有 6 題，全部作答，合計一百分。

（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。

（3）可使用計算機，close book。

1. What is ductility, and how is it measured? (10%)
2. In the stress-strain curve equation $\sigma = K\varepsilon^n$, what does the exponent n signify? What does it behave when $n = 0$ and $n = 1$? (15%)
3. What are the elements of a gating system of a casting pattern? (15%)
4. Please name and simply describe five kinds of major weld defects. (10%)
5. The engineering load-strain diagram shown in the Fig.1 was obtained from a tensile teston a specimen having an initial diameter of 12.0 mm. The diameter of fractured neck at point 2 was 6.25 mm. (i) Determine the true stress σ (Mpa) and true strain **ε** at point 1 and 2. (ii) Determine the value of the parameters ***n*** and ***K*** of the relationship $\sigma = K\varepsilon^n$. (25%)
6. A wire is drawn through a conical die shown as Fig.2-1 and Fig.2-2. If the friction is neglected. It is reduced from the initial diameter d_0 of 11 mm to the finan diameter d_1 of 6 mm. If the yield strength formula is $Y = Y_0 + K\varepsilon = 280 + 320\varepsilon$, v_d = 4mm/sec, ρc = 3.7(N/mm^2℃). Determine ε_1, Y_0(N/mm^2), Y_1(N/mm^2), F_d (N), and the drawing power P (kW). (25%)

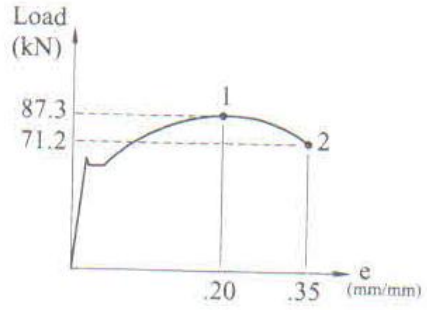


Fig.1

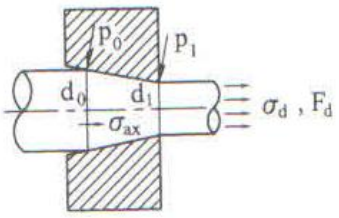


Fig.2-1

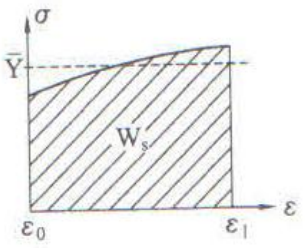


Fig.2-2

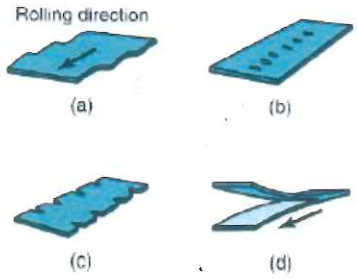
國立虎尾科技大學 107 學年度第一學期博士班資格考試題

所別：動力機械系機械與機電工程博士班　　第 1 頁 共 1 頁

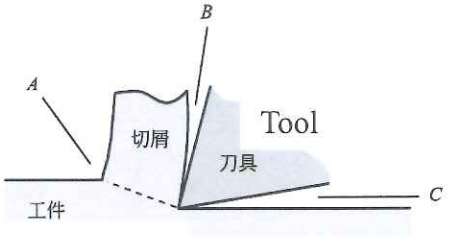
科目：機械製造

注意事項：（1）本試題共有 5 題，全部作答，合計一百分。（2）請依序作答於答案卷上並註明題號。（3）不可使用計算機，close book。

1. (a) Please explain the formation and destruction of BUE (Built-up Edge) in cutting process. (10%)
   (b) If you hope to reduce the tendency for BUE formation, what you can do? (10%)
2. (a) Please draw the pictures to show the climb milling and conventional milling. (10%)
   (b) What are the differences between the two methods (climb milling and conventional milling) applied in the face milling? (10%)
3. Please explain quenching, tempering, and annealing. (20%)
4. The following figure (a)~(d) shows the defects in rolled plates and sheets. Why the defects are happened? (20%)



5. The cutting fluids might be applied in 3 different directions shown in the following figure. Please describe the effects caused by different directions in the cutting? (20%)



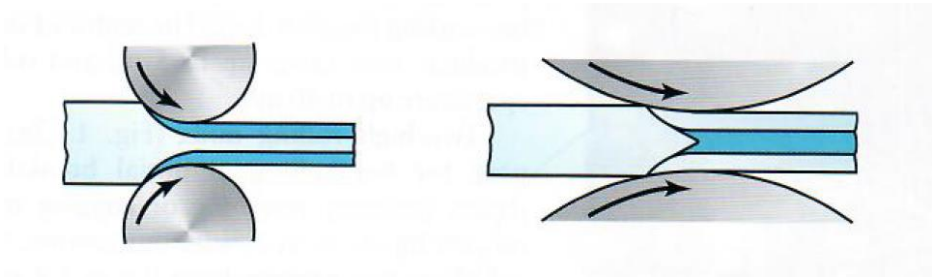
國立虎尾科技大學 107 學年度第二學期博士班資格考試題

所別：動力機械系機械與機電工程博士班　　第 1 頁 共 1 頁

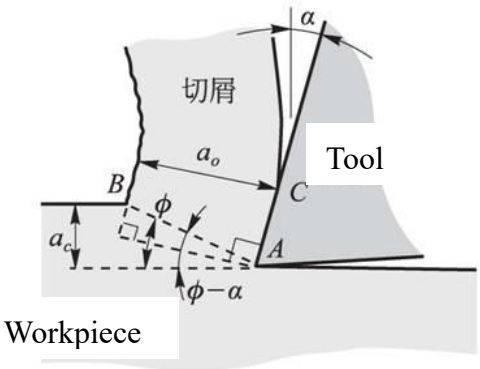
科目：機械製造

注意事項：（1）本試題共有 5 題，全部作答，合計一百分。（2）請依序作答於答案卷上並註明題號。（3）不可使用計算機，close book。

1. (a) Please show the indenters of Brinell Test, Vickers Test, and Rockwell Test. (10%)
   (b) Please show the symbols of the mentioned test shown in (a). (10%)
2. (a) Please explain the use of chip breaker. (10%)
   (b) Please show two types of chip breaker. (10%)
3. Please briefly show the manufacturing process of investment-casting (lost-wax) process. (20%)
4. In cold rolling of plates shown in the following figures, please draw the distribution of residual stresses of the two figures. (20%)



5. The orthogonal cutting shown in the following figure, please derive the relationship between cutting ratio (a_c/a_0) and the shear angle ϕ. α is the rake angle. (20%)



國立虎尾科技大學 108 學年度第一學期博士班資格考試題

系別：動力機械工程系機械與機電工程博士班　　第 1 頁　共 1 頁

科目：機械製造

注意事項：

（1）本試題共有 5 題，每題 20 分，合計一百分。

（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。

（3）禁止使用計算機/close book

1. **Explain the processing steps and uses of metal injection molding will be described?**

2. **Explain the principle, advantages and disadvantages of electrical discharge machining?**

3. **Explain the effects of hot forging, cold forging and warm forging on the shape and material properties of the product?**

4. **What is the purpose of case hardening? Explain the processing steps of case hardening?**

5. **Please draw and explain the principles of flat rolling processing?**

國立虎尾科技大學 109 學年度第一學期博士班資格考試題

系別：動力機械工程系機械與機電工程博士班　　第 1 頁　共 1 頁

科目：機械製造

注意事項：

（1）本試題共有 5 題，每題 20 分，合計一百分。

（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。

（3）可使用計算機/close book

1. **Explain the main construction and transmission steps of the indexing head?**

2. **What is the principle of punching shear processing? What kinds are there?**

3. **Discuss some of the defects that can occur in plastic injection molding?**

4. **What are the principal methods used to produce metallic powders?**

5. **A tensile test uses a test specimen that has a gage length of 50 mm and an area = 200 mm^2. During the test the specimen yields under a load of 98,000 N. The corresponding gage length = 50.23 mm. This is the 0.2 percent yield point. The maximum load of 168,000 N is reached at a gage length = 64.2 mm. Determine (a) yield strength, (b) modulus of elasticity, and (c) tensile strength. (d) If fracture occurs at a gage length of 67.3 mm, determine the percent elongation. (e) If the specimen necked to an area = 92 mm^2, determine the percent reduction in area.**

國立虎尾科技大學 109 學年度第二學期博士班資格考試題

系別：動力機械工程系機械與機電工程博士班　　第 1 頁　共 1 頁

科目：機械製造

注意事項：

（1）本試題共有 5 題，每題 20 分，合計一百分。

（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。

（3）可使用計算機/close book

1. **What are the three mechanisms of grinding wheel wear?**

2. **Discuss some of the defects that can occur in plastic injection molding?**

3. **What is the purpose of case hardening? Explain the processing steps of case hardening?**

4. **What is the principle of punching shear processing? What kinds are there?**

5. **Explain the principle, advantages and disadvantages of electrical discharge machining?**

國立虎尾科技大學 110 學年度第一學期博士班資格考試題

系別：動力機械工程系機械與機電工程博士班　　第 1 頁　共 1 頁

科目：機械製造

注意事項：

（1）本試題共有 5 題，每題 20 分，合計一百分。

（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。

（3）close book

1. **Explain the effects of hot forging, cold forging and warm forging on the shape and material properties of the product?**

2. **Explain the processes and applications of plastic injection molding?**

3. **What are the principal methods used to produce metallic powders?**

4. **What is the technical difference between blending and mixing in powder metallurgy?**

5. **What are the three mechanisms of grinding wheel wear?**

國立虎尾科技大學 110 學年度第二學期博士班資格考試題

系別：動力機械工程系機械與機電工程博士班　　第 1 頁　共 1 頁

科目：機械製造

注意事項：

（1）本試題共有 5 題，每題 20 分，合計一百分。

（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。

（3）可使用工程計算機/close book.

1. **A heat source transfers 3000 W to the surface of metal part. The heat impinges the surface in circular area, with intensities varying inside the circle. The distribution is as follows: 70% of the power is transferred within a circle of diameter= 5 mm, and 90% is transferred within a concentric circle of diameter= 12 mm. What are the power densities in (a) the 5 mm diameter inner circle and (b) the 12 mm diameter ring that lies around the inner circle?**

2. **A mold sprue length: 20 cm, and the cross-sectional area at its base: 2.5 cm^2. The sprue feeds a horizontal runner leading into a mold cavity whose volume is 1560 cm^3. Calculate: (a) velocity of the molten metal at the base of the sprue, (b) volume rate of flow, and (c) time to fill the mold.**

3. **A tensile test uses a test specimen that has a gage length of 50 mm and an area = 200 mm^2. During the test the specimen yields under a load of 98,000 N. The corresponding gage length = 50.23 mm. This is the 0.2 percent yield point. The maximum load of 168,000 N is reached at a gage length = 64.2 mm. Determine (a) yield strength, (b) modulus of elasticity, and (c) tensile strength. (d) If fracture occurs at a gage length of 67.3 mm, determine the percent elongation. (e) If the specimen necked to an area = 92 mm^2, determine the percent reduction in area.**

4. **A steel part with surface area A= 125 cm^2 is to be nickel-plated (the cathode efficiency for nickel is E= 0.95 and the plating constant C= 3.42 x 10^{-2} mm^3/amp-s). What average plating thickness will result if 12 amps applied for 15 min in acid sulfate electrolyte bath?**

5. **A gas tungsten arc-welding operation is performed at current of 300 A and voltage of 20 V. The heat-transfer factor f_1= 0.7, the melting factor f_2= 0.5, and the unit melting energy for the metal U_m = 10 J/ mm^3. Calculate (a) power in the operation, (b) rate of heat generation at the weld, and (c) volume rate of metal welded.**

國立虎尾科技大學 111 學年度第一學期博士班資格考試題

系別：動力機械工程系機械與機電工程博士班　　第 1 頁　共 1 頁

科目：機械製造

注意事項：

（1）本試題共有 5 題，每題 20 分，合計一百分。

（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。

（3）可使用工程計算機/close book.

1. **Explain the principle, advantages and disadvantages of electrical discharge machining?**

2. **In a tensile test, two pairs of values of stress and strain were measured for the specimen metal after it had yielded: (1) true stress = 217 MPa and true strain = 0.35, and (2) true stress = 259 MPa and true strain = 0.68. Based on these data points, determine the strength coefficient and strain-hardening exponent.**

3. **A round disk of 150 mm diameter is to be blanked from thickness of 3.2 mm, half-hard cold-rolled steel whose shear strength= 310 MPa, the clearance allowance Ac= 0.075. Calculate (a) the appropriate punch and die diameters and (b) blanking force.**

4. **An ECM operation used to cut a hole into a plate of aluminum that is 12 mm thick(specific removal rate C for aluminum= 3.44 x 10^{-2} mm^3/A^{-s}). The hole has a rectangular cross section= 10 mm x 30 mm. The ECM operation will be accomplished at current= 1200 amps. Efficiency expected to be 95%. Calculate the feed rate and time required to cut through the plate.**

5. **In a machining operation that approximates orthogonal cutting, the cutting tool has a rake angle= 10°. The chip thickness before the cut to= 0.5 mm and the chip thickness after the cut tc= 1.125 mm. Calculate the shear plane angle and the shear strain in the operation.**

國立虎尾科技大學 111 學年度第二學期博士班資格考試題

系別：動力機械工程系機械與機電工程博士班　　第 1 頁　共 1 頁

科目：機械製造 Mechanical Manufacturing

注意事項：

（1）本試題共有 5 題，每題 20 分，合計一百分。

（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。

（3）可使用工程計算機/close book.

1. **What are the principal methods used to produce metallic powders?**

2. **What properties determine the quality of a sand mold for sand casting?**

3. **The power source in a particular welding setup generates 3500 W that can be transferred to the work surface with a heat transfer factor= 0.7. The metal to be welded is low carbon steel, whose melting temperature (1760 ˚K). The melting factor in the operation is 0.5. A continuous fillet weld is to be made with a cross-sectional area= 10 mm^2. Calculate the travel speed at which the welding operation can be accomplished.**

4. **A sheet metal blank is to be bent as shown in figure. The metal has a modulus of elasticity = 205x 10^3 MPa, yield strength = 275 MPa, and tensile strength = 300 MPa. Calculate (a) the starting blank size and (b) the bending force if a V-die is used with a die opening dimension= 25 mm.**

5. **A 300 mm wide strip 25 mm thick is fed through a rolling mill with two powered rolls each of radius= 250 mm. The work thickness is to be reduced to 22 mm in one pass at a roll speed of 50 rev/min. The work material has a flow curve defined by K= 275 MPa and n= 0.15, and the coefficient of friction between the rolls and the work is assumed to be 0.12. Calculate the roll force, torque, and horsepower.**