

系所組別： 機械工程學系丁組

考試科目： 機械製造及材料

考試日期： 0225，節次： 2

1. Explain or distinguish the following terms: (12%)
 - (a) Single crystal vs amorphous structure
 - (b) Polymorphism vs isomerism
 - (c) T-T-T vs CCT diagram

2. (a) Cite the primary differences between elastic, anelastic, viscoelastic and plastic deformation behaviors. (4%)
(b) For a tensile test, it can be demonstrated that necking begins when $d\sigma_T/d\varepsilon_T = \sigma_T$. Using $\sigma_T = K\varepsilon_T^n$, determine the value of the true strain at this onset of necking. (6%)

3. (a) What are the slip systems for FCC and HCP structure (basal plane slip favored) respectively? (4%)
(b) Explain the difference between resolved shear stress and critical resolved shear stress. (4%)
(c) Consider a metal single crystal oriented such that the normal to the slip plane and the slip direction are at angles of 60° and 35° , respectively, with the tensile axis. If the critical resolved shear stress is 6.2 MPa, will an applied stress of 12 MPa cause the single crystal to yield? If not, what stress will be necessary? The value of $\cos 35^\circ$ equals to 0.819. (6%)

4. (a) Rank the following iron-carbon alloys and associated microstructures from the hardest to the softest: (1) 0.25 wt% C with coarse pearlite, (2) 0.80 wt% C with spheroidite, (3) 0.25 wt% C with spheroidite, and (4) 0.80 wt% C with fine pearlite. Justify this ranking. (4%)
(b) For a steel alloy it has been determined that a carburizing heat treatment of 10 hr duration will raise the carbon concentration to 0.45 wt% at a point 2.5 mm from the surface. Estimate the time necessary to achieve the same concentration at a 5.0 mm position for an identical steel and at the same carburizing temperature. (4%)
(c) Cite two major differences between martensitic and pearlitic transformations. (6%)

(背面仍有題目,請繼續作答)

系所組別： 機械工程學系丁組

考試科目： 機械製造及材料

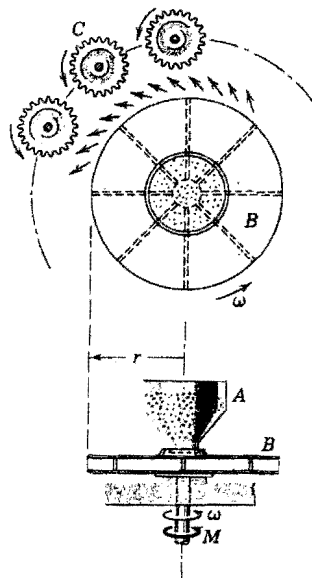
考試日期： 0225 · 節次： 2

5. 機械鑄造常會有熱量傳導問題。有一圓管鑄體，內半徑為 a ，外半徑為 b ，其內部被存放溫度為 T_1 之液體，外管溫度維持在 T_0 (且 $T_0 < T_1$)，若 k 為該管之熱傳導係數， T 為半徑 r 處之溫度。

- (1) 若圓管長度很長，則其溫度分佈問題是空間幾維(dimension)問題？(2%)
- (2) 求圓管之截面積(2%)；
- (3) 求圓管截面半徑 r 處的圓週長(2%)；
- (4) 若向外熱流率 $Q = -k(2\pi r) \frac{dT}{dr}$ ，該方程式為何有負號(2%)？
- (5) dT/dr 的物理意義是什麼(2%)？
- (6) 寫出本熱傳導的邊界條件(2%)；
- (7) 導出圓管之穩流溫度分佈方程式(3%)。

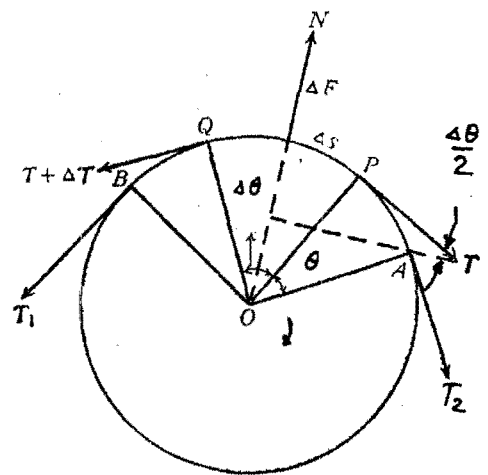
6. 如圖所示乃是珠擊法(shot peening) 珠擊齒輪。

- (1) 珠擊法是熱加工法或冷工法？其溫度是再結晶溫度之上嗎(2%)？
- (2) 珠擊法的目的是什麼(2%)？
- (3) 若珠體的質量是 m ，且 B 葉扇的 rpm 轉速是 n ，rpm 是什麼單位(2%)？
- (4) B 葉扇角速度每秒是多少(2%)？
- (5) 每一珠體離開葉扇的能量是多少(2%)？



7. 工廠作業常需要皮帶輪。現在分析皮帶在輪上滑動之情形。如圖所示乃皮帶與輪之情況。考慮皮帶之一小段 ΔS ，端點為 P 與 Q，P 與 Q 向中心之角為 $\Delta\theta$ ，若皮帶不動而輪繞中心 O 作順時針轉動，令端點 P 之張力為 T，端點 Q 之張力為 $T + \Delta T$ ，並設 P Q 上所受法線合力是 ΔF ，若 μ 是動摩擦係數。

- (1) 動摩擦力是多少？作用的方向是在何方向(畫圖示意)？(4%)
- (2) 寫出法線方向的靜力平衡方程式。(3%)
- (3) 寫出切線方向的靜力平衡方程式。(3%)
- (4) 若 $\Delta\theta$ 很小，由(2)與(3)求出法線與切線方向的靜力平衡方程式。(3%)
- (5) 由(4)證明 $dT/d\theta = \mu T$ 。(2%)



8. 以高速鋼車車削直徑 45 mm 中碳鋼，設其切削速度是 20 (m/min)，則車床每分鐘之迴轉速是多少？(3%)

9. (1) 如圖，銑刀直徑 D，切削深度 t，則刀刀與工件嚙合角度 $\phi = ?$ (將 ϕ 表示成銑刀直徑與切削深度的函數)(3%)
- (2) 若 ξ 是刀刀的角節距，若銑刀刀刀數是 z，則 $\xi = ?$ (2%)
- (3) 若銑刀至少有兩個刀刀與工件嚙合才能做切削工作，則 $\phi/\xi \geq 2$ ，則該銑刀最小刀刀數是多少？(2%)

