編號： 74

國立成功大學 104 學年度碩士班招生考試試題

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：0211，節次：2

※ 考生請注意：本試題可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

機械材料試題:

1、 試說明金屬材料鍵結的原理及該鍵結所反應出的金屬相關特性。(10%)

2、 試配合圖示說明金屬材料冷加工後退火過程中，其顯微結構與機械特性的變化。(10%)

3、 試推算出 BCC 結構在[110]方向上的原子線性密度(Linear density)，及 FCC 結構在(111)平面上的原子密度(planar density)。(10%)。

4、 一初始含有 0.15%C 的 FCC 鐵碳合金於高溫下進行滲碳處理，滲碳氣氛表面濃度維持在 1.30%C；若在 36 小時後，於表面下 3.0mm 處之碳濃度是 0.38%，試決定滲碳處理時之溫度（已知$D_0 = 2.3 \times 10^{-5}\ m^2/s$，$Q_d = 148\ KJ/mol$，$R = 8.31 J/mol \cdot K$）。(10%)

z	erf(z)
0.80	0.7421
0.85	0.7707
0.90	0.7969
0.95	0.8209

5、 有一直徑 0.25cm 長度 25cm 的金屬圓桿，承受 4500N 的拉力；若受力後直徑縮減為 0.22cm，試計算：

(1) 金屬圓桿的最後長度 (4%)；

(2) 此荷載下的真應力與真應變。(6%)

機械製造試題接下頁:

國立成功大學 104 學年度碩士班招生考試試題

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：0211，節次：2

機械製造試題:

6. Draw a typical engineering stress-strain diagram of a tensile test for low carbon steels. Mark and identify on the diagram the following mechanical properties or terms: (1). tensile strength, (2). yield strength, (3). breaking stress, (4). elongation, (5). elastic region, (6). plastic region, (7). Young's modulus, (8). necking, (9). strain hardening, and (10). toughness. (10%)

7. Mold and pattern are important elements of a casting process. In Table 1, five common casting processes are listed. Redraw the table on your answer sheet and mark an 'X' for the type of pattern and mold used by each casting process. (10%)

8. Calculate the force required in direct extrusion of 1100-O aluminum from a diameter of 150 mm to 50 mm. Assume that the redundant work is 25% of the ideal work of deformation, and the friction work is 30% of the total work of deformation. (The 1100-O aluminum material properties K=180 MPa; n=0.2). (10%)

9. A 150 mm-long, 12.5 mm-diameter 304 stainless-steel rod is being reduced in diameter to 12.0 mm by turning on a lathe. The spindle rotates at N=500 rpm and the tool is travelling at an axial speed of 200 mm/min. Calculate the cutting speed, material-removal rate, cutting time, power dissipated, and cutting force. (specific cutting energy: 4.0 $\mathrm{W\text{-}s/mm^3}$) (10%)

10. Figure 1 shows the residual stress of a material to be σ_t = 150 MPa and σ_c = -150 MPa. The material is steel (E = 200 GPa), and the length of the specimen is 0.5 m. (1) Calculate the length to which this specimen should be stretched so that, when unloaded, it will be free from residual stresses and (2) explain via a stress-strain diagram to show why these residual stresses can be eliminated or reduced by stretching. Assume that the material is elastic, perfectly plastic and has a yield stress of 300 MPa. (10%)

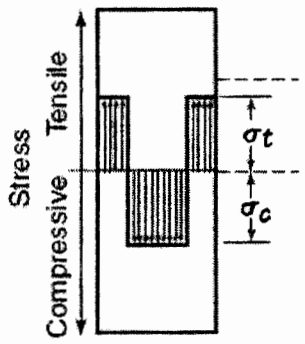

Fig. 1 Residual stress

Table 1 Types of mold and pattern used in various casting processes.

	Permanent -mold	Expendable-mold	Permanent-pattern	Expendable-pattern	No pattern
Sand Casting					
Centrifugal Casting					
Investment Casting					
Evaporative-patter n Casting					
Die Casting					