

國立成功大學

111學年度碩士班招生考試試題

編 號： 69

系 所： 機械工程學系

科 目： 機械製造及材料

日 期： 0219

節 次： 第 2 節

備 註： 可使用計算機

※ 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。

1. Please explain the following questions: (16%) :

- (a) What is the difference between the grain boundary and phase boundary?
- (b) Do amorphous materials display the phenomenon of allotropy (or polymorphism)? Why?
- (c) Are the covalently bonded materials more or less dense than metallically bonded ones? Why?
- (d) Briefly explain the difference between self-diffusion and inter-diffusion.

2. (a) For some transformation having kinetics that obey the Avrami equation (Eq. 1, n & k : transformation specific parameters independent of time), the parameter n is known to have a value of 1.7. If, after the time (t) of 100 s, the reaction fraction (y) is 50% complete, how long (total time) will it take the transformation to go to 99% completion? (12%)

$$y = 1 - \exp(-kt^n) \quad (1)$$

- (b) Please describe the phenomena of supercooling. Why does it occur? (4%)
 - (c) Name the two stages involved in the formation of particles of a new phase. Briefly describe each. (4%)
3. (a) What are the slip systems for FCC and HCP structure (basal plane slip favored) respectively? (4%)
- (b) 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? (10%)

※ 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。

4. Short answer question (25%)

- 1) Please explain the causes of built-up edge (BUE) and suggest improving it. (3%)
- 2) Please explain why the contact length between the cutting tool and the chip should be reduced. Also, is this contact length can set to zero? (3%)
- 3) The total cutting power in the cutting process can be summed up by shear power and friction power; please list the expression of power. (3%)
- 4) Please describe the characteristics should cutting tools have? (3%)
- 5) Why are chemical stability and inertness are essential to cutting tools? (3%)
- 6))What tool and specification do you recommend if you cut nickel-based superalloy with a turning tool? Why? (3%)
- 7) Please elaborate on the similarities and differences between hard and soft welding, fusion welding, and solid-state welding? (3%)
- 8) What method do you recommend combining two nickel-based superalloys? Why? (4%)

5. A round rod of annealed low carbon steel is drawn from a diameter of 10 mm to 8 mm at a speed of 0.5 m/s. Assume that the frictional and redundant work together constitute 40% of the ideal deformation work. (a) Calculate the power required in this operation, and (b) What material is recommended to make the mold. (15%)

6. The cutting parameters for orthogonal cutting are $t_o=0.13$ mm, $V=120$ m/min, $\alpha=10^\circ$, cutting width of 6 mm, and $t_c=0.23$ mm, $F_c=500$ N, $F_t=200$ N are observed. Calculate the percentage of total energy consumed to overcome the friction between the tool and the chip. (10%)