

國立成功大學

113學年度碩士班招生考試試題

編 號：68

系 所：機械工程學系

科 目：機械製造及材料

日 期：0201

節 次：第 1 節

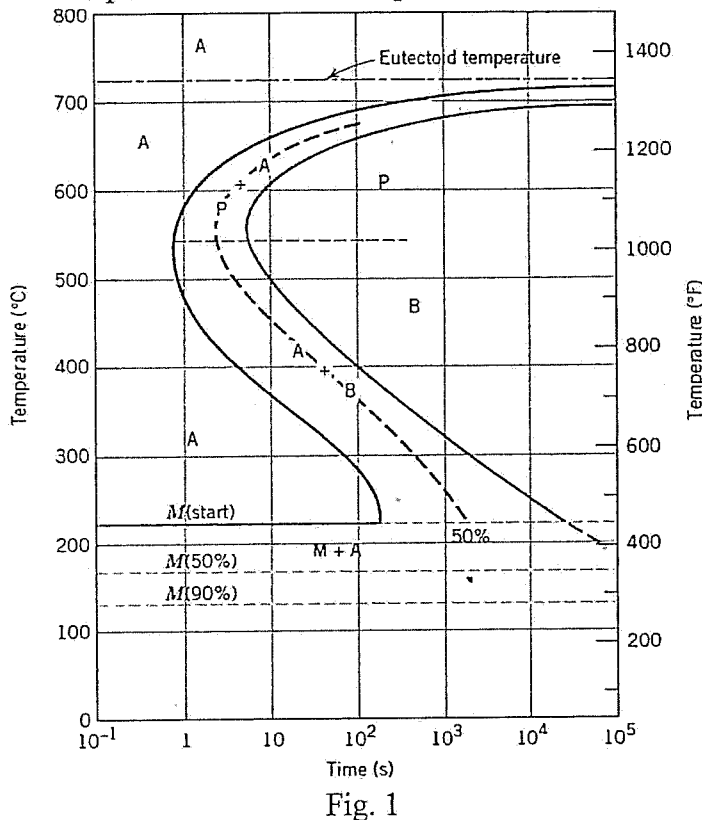
備 註：可使用計算機

※ 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. Explain or distinguish the following terms: (12%)

- (a) Twinning vs slip (deformation) (b) Grain boundary and Hall-petch equation
 (c) Fracture Toughness (K_{IC}) vs Plane strain fracture toughness (K_{IC})

2. Using the isothermal transformation diagram as shown in Fig. 1 determines the final microstructure of a small specimen or sketch the paths that has been subjected to the following temperature treatments. (18%)



- (a) Rapidly cool to 250 °C, hold for 100 s, then quench to room temperature. Assume the specimen begins at 920 °C and has been held at 920 °C long enough to have achieved a complete and homogeneous austenitic structure. (4%)
- (b) Rapidly cool to 350 °C, hold for 10⁴ s, then quench to room temperature. (4%)
- (c) Rapidly cool to 650 °C, hold for 20 s, rapidly cool to 400 °C, hold for 10³ s, and then quench to room temperature. (5%)
- (d) Sketch and label the time-temperature paths to produce the 50% fine pearlite and 50% bainite microstructure on Fig. 1. (5%)

3. (1) The metal M has a FCC crystal structure. If the angle of diffraction for the (220) set of planes occurs at 73.22° (1st-order reflection) when monochromatic x-ray wavelength of 0.1768 nm is used, compute (a) the interplanar spacing for this set of planes, and (b) the atomic radius for the M atom. (12%)
- (2) Calculate the atomic packing factor for BCC and FCC. (8%)

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4. Short Answer Question

- 1) What's manufacturing? (5%)
- 2) Please explain the forming and shaping process and list common processes. (5%)
- 3) What are the functions of mold and pattern in the casting process? (5%)

5. Assume that a cellulose-epoxy reinforced plastic with longitudinal wood fibers contains 30% cellulose fibers. The elastic modulus of the fiber is 140 GPa, and that of the epoxy matrix is 100 GPa. Calculate the elastic modulus of the composite and the fraction of the load supported by the fibers. (15%)

6. In an orthogonal cutting operation, $t_0 = 0.15$ mm, $V = 150$ m/min, $\alpha = 10^\circ$ and the width of cut = 6 mm. It is observed that $t_c = 0.25$ mm, $F_c = 600$ N, and $F_t = 300$ N. Calculate the percentage of the total energy that goes into overcoming friction at the tool-chip interface. (20%)