國立成功大學 106 學年度碩士班招生考試試題

系　　所：機械工程學系

考試科目：機械製造及材料

考試日期：0213，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。

1. Explain or distinguish the following terms: (16%)

   (a) Engineering stress vs. true stress　　(b) Hypoeutectoid vs. hypereutectoid steels

   (c) Recovery and recrystallization　　(d) Interdiffusion vs. self-diffusion

2. (a) What is the Hall-Petch relationship? (4%)

   (b) The lower yield point for an iron that has an average grain diameter of $5*10^{-2}$ mm is 135 MPa. At a grain diameter of $8*10^{-3}$ mm, the yield point increases to 260 MPa. At what grain diameter will the lower yield point be 205 MPa? (10%)

3. Using the isothermal transformation diagram for a 0.45 wt% C steel alloy (Fig. 1), determine and justify the final microstructure (in terms of just the microconstituents present) of a small specimen that has been subjected to the following time-temperature treatments. In each case assume that the specimen begins at 845°C, and that it has been held at this temperature long enough to have achieved a complete and homogeneous austenitic structure. (20%)

   (a) Rapidly cool to 250 °C, hold for 103 s, then quench to room temperature.
   (b) Rapidly cool to 700 °C, hold for 30 s, then quench to room temperature
   (c) Rapidly cool to 400 °C, hold for 500 s, then quench to room temperature
   (d) Rapidly cool to 700°C, hold at this temperature for 105 s, then quench to room temperature
   (e) Rapidly cool to 625°C, hold for 1 s, then quench to room temperature

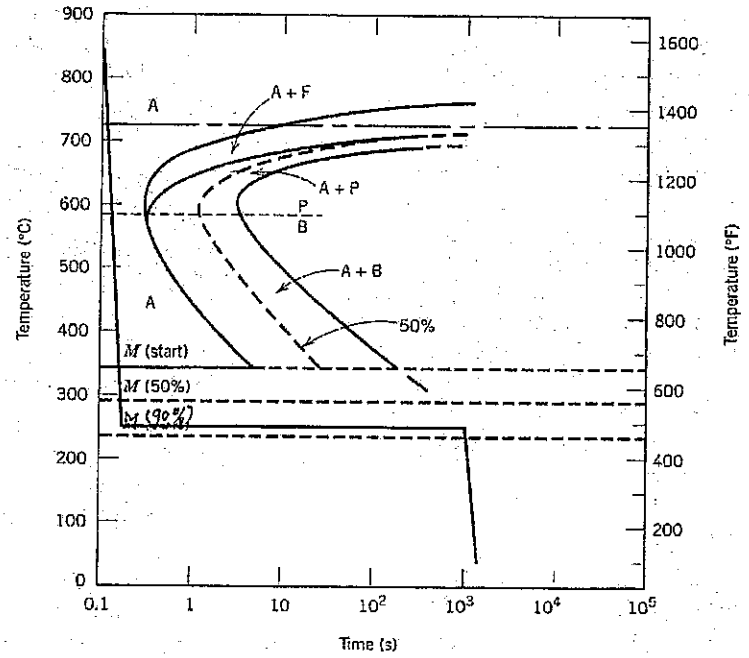

Fig. 1

4. Drawing a typical engineering stress-strain diagram of a tensile test for low carbon steels. Mark and identify on the diagram the following mechanical properties of items: (a) tensile strength (2%), (b) yield strength (2%), (c) breaking stress (2%), (d) elongation (2%), (e) elastic region (2%), (f) plastic region (2%), (g) young's modulus (2%), (h) necking (2%), (i) strain hardening (2%), and (j) toughness (2%).

5. For alloys of two hypothetical metals A and B, there exist an α, A-rich phase and a β, B-rich phase. From the mass fractions of both phases for two different alloys(given below), which are at the same temperature T℃, determine the composition of the phase boundary(or solubility limit) for (a)α (10%) and (b)β phases (10%) at T℃.

Alloy composition at T℃	Fraction α phase	Fraction β phase
60wt%A—40wt%B	0.55	0.45
30wt%A—70wt%B	0.15	0.85

(Hint: you may need to draw a binary phase diagram for calculation.)

6. Using the Taylor equation to calculate the tool life, let n = 0.3, calculate the percentage increase in tool life when the cutting speed is reduced by (a) 20% (5%) and (b) 70% (5%), respectively.