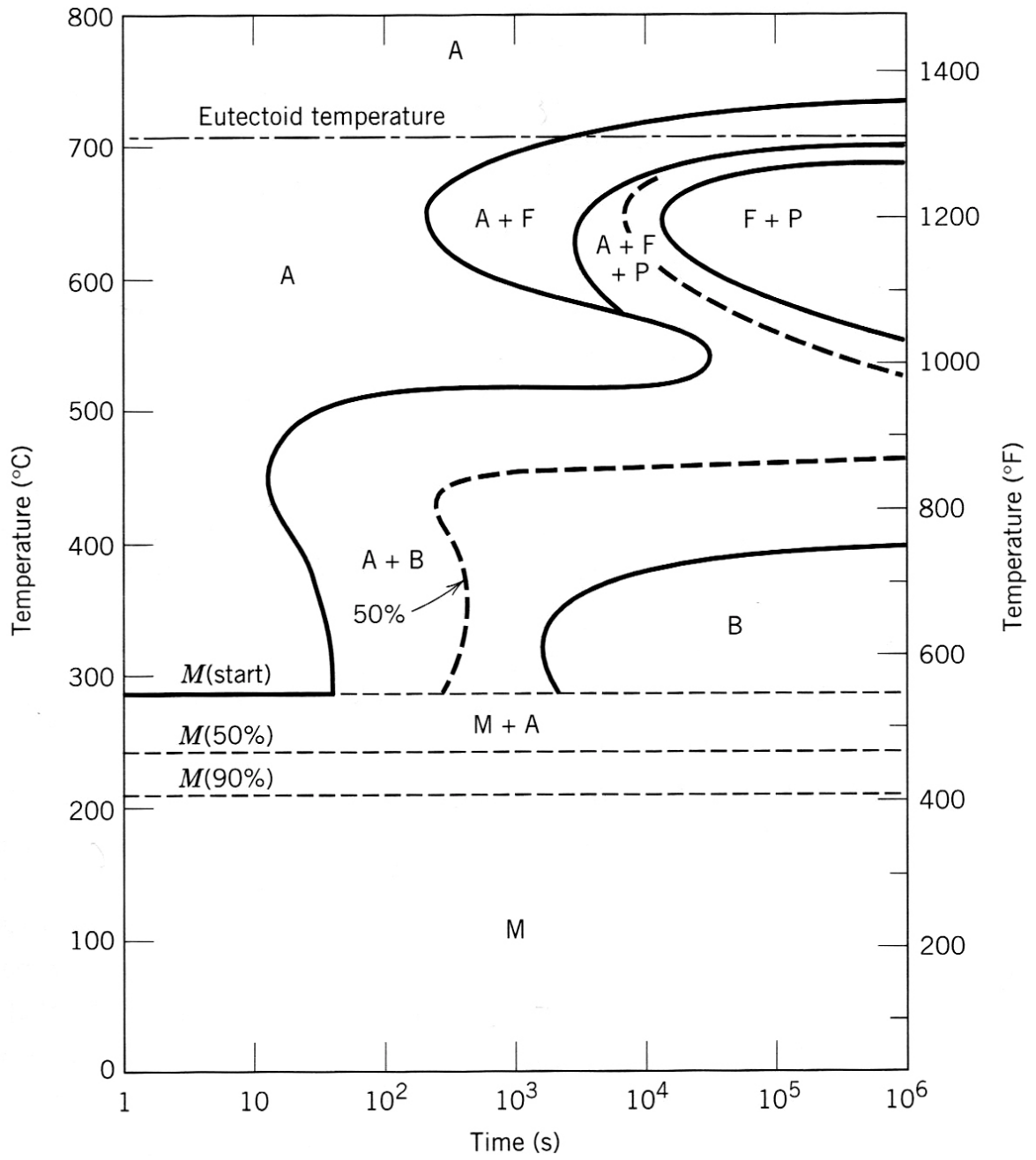


**ENGR 240 Science of Materials**  
**Homework 14 (13 points)**  
Due Wednesday, April 11

1. [4 points] Using the Fe-Fe<sub>3</sub>C phase diagram, make schematic microstructural sketches for the following conditions. Label the phases and microconstituents in your sketches.
  - a. Steel with 0.30 wt.% carbon that has been heated to 900 °C and very slowly cooled to room temperature
  - b. Steel with 0.90 wt.% carbon at 800 °C.
  
2. [1 point] How does the austenite to martensite transformation differ from the austenite to bainite transformation?
  
3. [2 points] The TTT diagram for AISI 4340 steel (Fe with Cr, Mo, Ni, and 0.40 wt.% C) is given on the following page. On the TTT diagram, sketch isothermal paths that will result in the following microstructures:
  - a. 100% bainite.
  - b. 50% bainite, 50% martensite
  - c. 100% martensite.
  - d. 100% coarse pearlite + proeutectoid ferrite.
  
4. [4 points] Given the AISI 1045 steel (plain medium carbon steel with 0.45 wt.% C) TTT diagram on the back of this page, tell what phases and microconstituents will result from the following isothermal heat treatments:
  - a. Austenitize (transform entire sample to austenite phase), cool rapidly to 350 °C and hold for 10 sec, quench in water.
  - b. Austenitize, cool rapidly to 700 °C and hold for 1 minute, quench in water.
  - c. Austenitize, cool rapidly to 600 °C and hold for 10<sup>5</sup> sec, quench in water.
  - d. Austenitize, quench in water.
  
5. [2 points] Use the given AISI 1045 steel TTT diagram to construct schematic plots of the expected trends in (i) strength and (ii) ductility as a function of steel transformation temperature. Use a temperature range of 0 to 700 °C on your transformation temperature axis (x-axis).

# 6. TTT Diagram for AISI 4340 Steel (Problem 3)



TTT Diagram for AISI 1045 Steel  
(Problems 4 and 5)

