

Name: _____ Student ID No: _____

Faculty of Engineering Prince of Songkla University

การสอบปลายภาคการศึกษาที่ 1

ปีการศึกษา 2549

วัน พุธที่ 5 ต.ค. 2549

เวลา 13:30 – 16:30 น.

วิชา 237-322

ห้อง R300

คำสั่ง

- (1) เขียนคำตอบให้สมบูรณ์ทุกข้อเพื่อให้ได้คะแนนเต็ม
- (2) ไม่อนุญาตให้นำเอกสารทุกชนิดเข้าสอบ
- (3) ให้เอา Calculator และ Dictionary เข้าห้องสอบได้
- (4) ข้อสอบมี 12 ข้อ ทั้งหมด 10 หน้า ให้ตรวจสอบให้เรียบร้อยก่อนสอบ
- (5) อ่านคำสั่งให้ละเอียด และตอบทุกคำถาม

ทุจริตในการสอบโทษขั้นต่ำคือปรับตกในรายวิชาที่ทุจริตและพักการศึกษา 1 ภาคการศึกษา

Question No.	Point	Result
1	18	
2	12	
3	10	
4	15	
5	3	
6	6	
7	5	
8	5	
9	5	
10	5	
11	10	
12	6	
Total	100	

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Part I of Dr. Jessada (40 points)

1. Describe the following metals: What are they? What are the alloying elements? What are the applications? (18 points).

1.1 ADC12

1.2 Brass

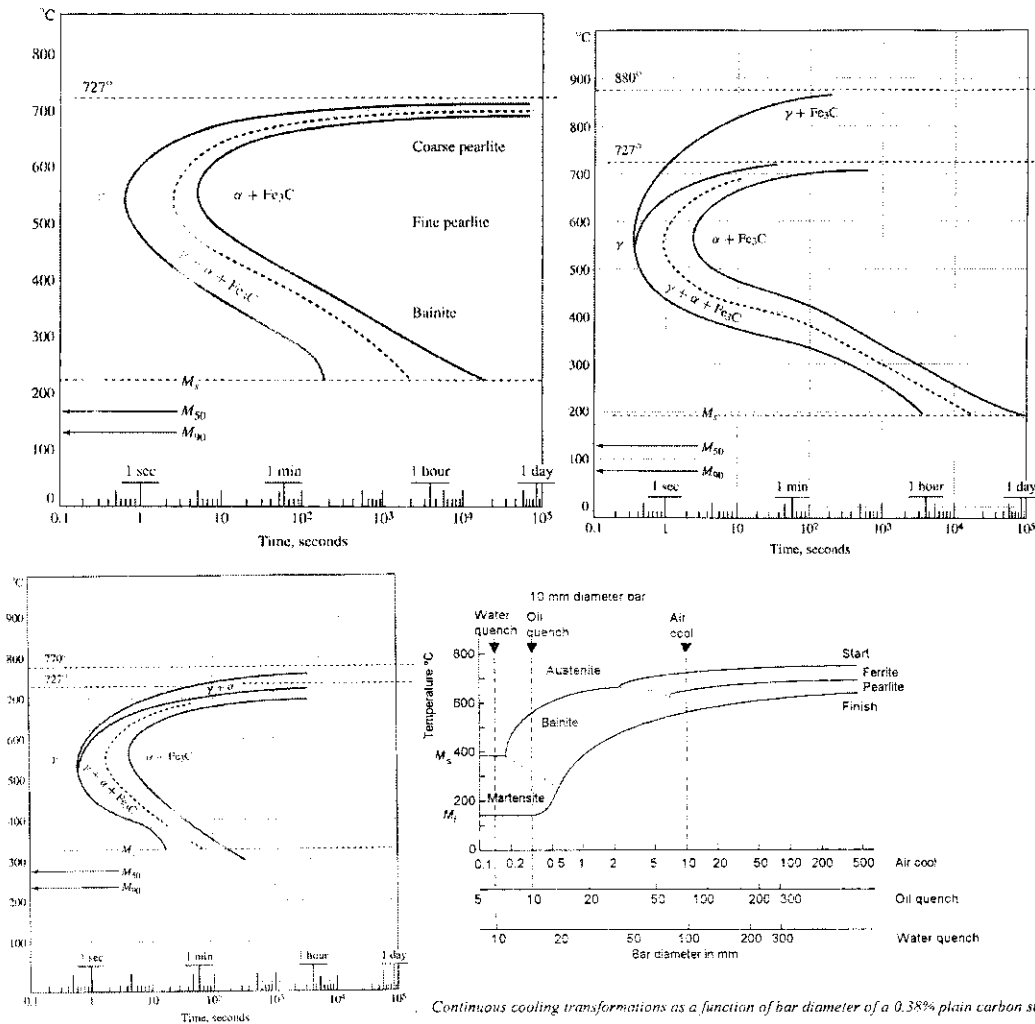
1.3 AZ91D

1.4 H13

1.5 Titanium-6-4

1.6 ZAMAK-3

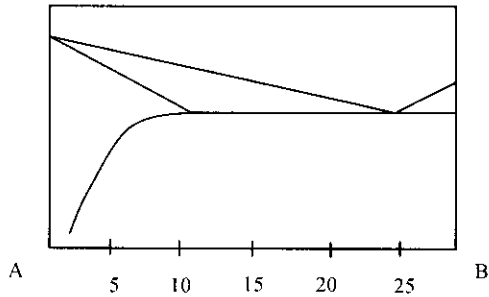
2. a) Your manager wants you to heat treat a hypereutectoid steel to have the microstructure consisting of 25% fine pearlite, 25% bainite and 50% *tempered* martensite. Describe the **heat treatment procedure** clearly by selecting the right diagram given below (12 points). Draw the lines also!



Continuous cooling transformations as a function of bar diameter of a 0.38% plain carbon steel

3) Answer the following questions (10 points):

- a) For the alloy A-B, what is maximum amount of B that allows precipitation hardening to occur? (%B = ?) Explain. (2 points)



- b) In steel-making processes, why are silicon or aluminum added to the steel? (2 points).

- c) A cast iron contains 2.5% C and 2.7% Si, what is the carbon equivalent of this cast iron? (1 point)

Is this cast iron eutectic, hypereutectic, or hypoeutectic? (1 point)

If this cast iron is solidified from liquid with very slow cooling rate and also cooled down with very slow cooling rate during the eutectoid temperature range. What is the final microstructure? Explain and draw the microstructure. (4 points)

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Part II of Dr. Weerawan (60 points)

4. Fill in the following table to describe and compare main characteristics of three main classes of stainless steels (ferritic, austenitic and martensitic) including their major composition, their advantages and limitations, also give an example of common AISI grade and applications. (15 marks)

Type of SS	Ferritic	Austenitic	Martensitic
Major compositions			
Hardenability (How can it be hardened?)			
Magnetic property (Is it magnetic?)			
Advantages			
Limitations			
Example of common AISI grade and applications			

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5. "304L" is a type of stainless steel. What does the "L" designation mean? And what is its advantage compare to grade 304? (3 marks)

6. Briefly describe the following types of corrosion that may occur in stainless steel:

- Pitting and briefly discuss how to decrease the amount of pitting. (3 marks)

- Weld decay and briefly discuss how you would prevent or reduce it. (3 marks)

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7. What are ordered intermetallics? Describe their main characteristics/important properties, advantages and limitations and potential applications. (5 marks)

8. Describe the term “Self-propagating High-temperature Synthesis (SHS)” including their advantages and effecting parameters. (5 marks)

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9. What is “Duplex stainless steel”? Describe its main characteristics/important properties, advantages compared to austenitic and ferritic stainless steels and common applications. (5 marks)

10. What are shape memory alloys? Briefly describe the term “Nitinol” including main characteristics/important properties and give three examples of application. (5 marks)

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11. Describe the following terms including main compositions, their characteristics/ important properties, advantages and applications (10 marks)

- Precipitation hardenable (PH) stainless steel

- Superalloys (also briefly compare the three classes of superalloys)

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12. (i) What are the benefits of a thermal barrier coating system (TBC) applied to a Ni-based superalloy rotating blade in a gas turbine engine? What are the key properties desired in candidate materials for such a coating? (4 marks)

(ii) Typically two layers of coating (top coat and bond coat) are necessary for the complete TBC system. Suggest the materials currently used for both layers that meet the requirements above and give your reason. (2 marks)