University of Saskatchewan
College of Engineering
Dept. of Mech. Engineering
ME 330.3 Final Examination
Dec. 1998

Part	Mark
Part I	
Part II	
Part III	
Part IV	
Part V	
Total	

Time: 2 Hours   **Instructors: Rich Burton and Chris Zhang**
Open Book Exam.

Name:_____

Student Number:_____

This exam consists of **five** parts. Attempt all questions**.**
Do all work on this examination paper.

Part I. (20 marks, 2 marks per question)

1. In wire drawing, multiple drawing passes are often required to get the desired size. Why is this?

2. In rolling mills, there are advantages to be gained by using a smaller rolling diameter in the rolls. What are they?

3. What is the technical distinction between impression–die forging and true closed die forging?

4. Define the <u>technical </u>differences between a bloom, a billet and a slab.

5.   List the advantages of investment casting.

6.   What is the hard brittle phase of steel that gives it its unique ability to be strengthened to very high values?

7.   Define the technical name for the following methods:

   (a) Heating a surface by means of one or more torches followed by rapid quenching

   (b) localized treatment in which high energy electron densities are applied to a small region.

8.   What is the basic principle that is used in the good design of the riser in a mold?

9.   What are the various types of permanent mold casting?

10.   How are the isotropic strength properties created in blown film extrusion?

Part II (10 marks in total)

1. What is the main purpose of specifying tolerance?   **[1 mark]**

2. What are two standards internationally applicable to design and manufacturing for tolerance specification?   **[1 mark]**

3. List types of fits in the ISO standard, and explain them. What is the main difference between fits and tolerance?   **[2 marks]**

4. Write out at least three pieces of information that can be obtained from the tolerance specification shown below: **[3 marks]**

    50 H7 /d7

5. In an assembly we have the following conditions: **[3 marks]**

- A shaft is going to be assembled with two holes (A and B) for different assembly requirements. The assembly requirement between hole A and the shaft is of clearance fit but between hole B and the shaft is of interference fit.
- The required motion between the shaft and hole A is of close running.
- The basic size of the shaft is 38 (mm)

  Determine the maximal clearance between hole A and the shaft (Tables 1 through 4 are appended for your use)

Table 1. Preferred sizes   **Table 2. Preferred fits**

Table 3. Preferred Metric Hole Basis Clearance Fits

Table 4. Preferred Metric Shaft Basis Clearance Fits

Part III (23 marks total)

Figure 1 shows the handle and the body segment of a relatively large ratchet wrench, such as those used with conventional socket sets. The design specification requires a material with a minimum yield strength of 55,000 psi and an elongation of at least 2% in all directions. Additional consideration should be given to weight minimization (because of the relatively large size of the wrench), corrosion resistance (due to storage and type of environment), and appearance. Furthermore, there is no equipment available to machine the surface which has <u>different</u> thicknesses. Mass production is assumed.

1. Based on the size and shape of the product, describe several possible methods by which the component could be produced. For each method, briefly discuss its relative pros and cons.
2. What types of engineering materials might be able to meet the desired requirements? What would be the pros and cons of each general family of material?
3. Which of the above alternatives do you feel would be the "best" solution to the problem? Why?
4. For your proposed solution in the preceding question 3, would any additional heat treatment or surface treatment be required? If so, what would you recommend?
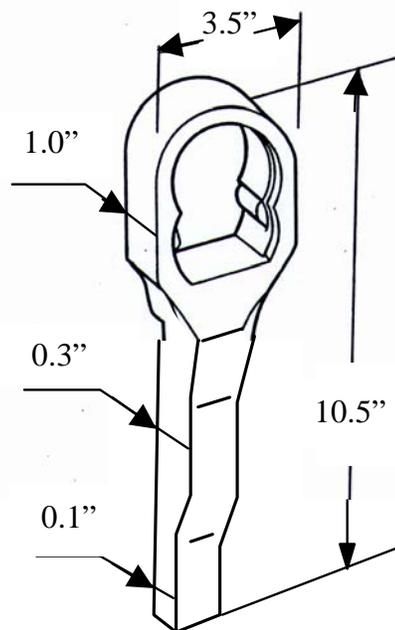

Figure 1

Part III continued

Part IV   (12 marks)

A hot rolling mill has rolls of diameter = 24 in. It can exert a maximum force equal to 400,000 lb. The mill has a maximum horsepower of 100 hp (39×10^6 in lb/min). It is desired to reduce a 1.5 in.-thick plate by the maximum possible draft in one pass. The starting plate is 10 in. wide. In the heated condition, the work material has a strength coefficient equal to 20,000 lb/in^2 and a strain hardening exponent equal to 0. Determine

(a)   the maximum possible draft,

(b)   the associated true strain,

(c)   the maximum speed of the rolls for the operation (ft/min).

Part V (35 marks total)

Consider the "Burton-Zhang Confligaltionaleity processor" (i.e., paperweight) illustrated in Figure 2. You are to design a sand cast mold to manufacture this part (including cast part, riser, sprue etc.). Clearly define all steps, and assumptions. Some information pertaining to the metal used is indicated below. Your solution should appear as a report to a senior engineer and hence the <u>organization</u> and <u>appearance</u> as well as <u>content</u> will be graded.
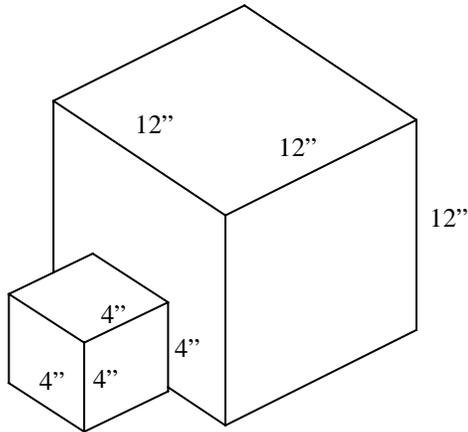

Figure 2

Volumetric Contraction due to solidification shrinkage = 1%
Volumetric Contraction due to solid thermal contraction = 3%
Eutectic Alloy (Cast Iron – 4.3% C)
Density: .15 lb/in^3.
Specific heat 0.082 BTU/lb^{o}F (solid), .071 BTU/lb^{o}F (liquid)
heat of fusion = 72 BTU/lb,
mold constant = 15 min/in^2

Part V continued

Part V continued (if necessary)

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