University of Saskatchewan
College of Engineering
Dept. of Mech. Engineering
ME 330.3 Final Exams
April 2005

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

Name: _____

Student Number: _____

This exam question set consists of **two** parts. Part I consists of **10** questions. Part II consists of **3** questions.

Attempt all questions**.**

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Part I. (40 marks)

Question I.1
The wire drawing is a metal forming process. The basic principle of the metal forming process is the plastic deformation of material, which means that the stress in material is over the yield stress. However, in the wire drawing, we use multiple drawing passes in order to avoid the situation that the stress in material is over the yield. Is there any contradictory here? Please explain.

Question I.2
What is the major difference between the eutectic and eutectoid compositions? Why are alloys of eutectic composition attractive for casting and as filler metals in soldering and brazing?

Question I.3
In the casting process, the pouring temperature is one of the parameters affecting the quality of a casting. Increase of the pouring temperature relative to the freezing point of the metal has both good points and bad points with respect to the quality of a casting. List one good point and one bad point with the increase of pouring temperature and explain why.

Question I.4
List one difference and one similarity between the rapid prototyping technology and powder metallurgy technology.
Question I.5

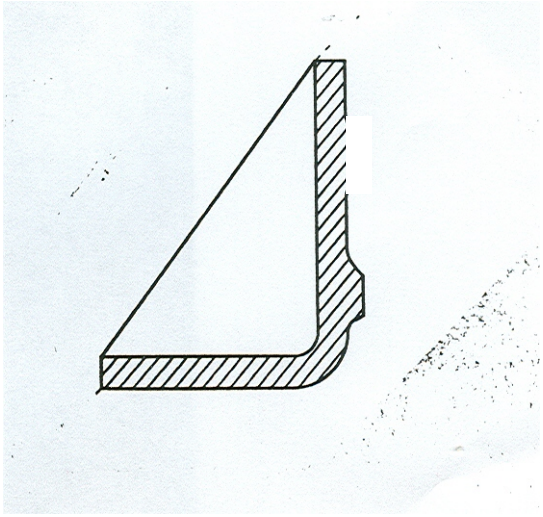
What is called the chill zone in a casting, and why does it form?

Question I.6
What is the ISO 9000? What is the basic rationale for this standard?

Question I.7
What is the role of the riser in the casting process? Explain any conflicting situation in the riser design.

Question I.8
Aluminum is a non-ferrous metal. Please outline some particular manufacturing processes on the aluminum, one for each of (1) how to strengthen it as a whole, (2) how to harden its surface.

Question I.9
The following figure shows a part for casting. Decide the parting line for the part and give the rationale for your decision.



Question I.10
The following is the tolerance specification: 50 G7 /h8. Please indicate (a) whether it is the basic hole system or the basic shaft system, and why? (b) whether it is the clearance fit or interference fit, why? (c) whether the sand casting process may be appropriate for such a quality, why?

Part II (60 marks total)

Question II.1

Define the **yield** of a casting as the casting weight divided by the total weight of metal poured (sprue, gate, riser, and casting). A particular casting has the following dimension: the rectangular plate with 2 in. by 4 in. by 6 in. Consider two situations to locate the riser: Situation (1): the riser and casting are not in direct contact, and Situation (2): the riser sits on the top of the flat rectangle with its bottom circular surface being part of the surface of the casting. Further, the riser has the cylindrical form. Please:

(a) Find the optimum dimension relationship for the riser in situation (1) and situation (2), respectively.
(b) Find the dimension of the riser for both situation (1) and situation (2) assuming that the TST of the riser is 30% longer than that TST of the casting.
(c) For these two situations above, calculate the **yield** of them, respectively, and comment on which situation (1) or (2) is more efficient. Assume that the volume of the sprue and gate can be ignored for the situation (1).

Question II.2

A hot rolling mill has the 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, and
(c) the maximum speed of the rolls for the operation (ft/min).

Question II.3

In the metal forming, we have the concept called the **average flow stress**. The average flow stress is calculated by

$$\overline{Y}_f = \frac{K\varepsilon^n}{1+n} \qquad (1)$$

Please do the following:

(a) Derive the flow stress equation, equation (1);
(b) In the case of the rolling process, what is the definition of the true strain in equation (1) above, and why?
(c) In the case of the drawing process, what is the definition of the true strain in equation (1) above, and why?

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