NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

MANUFACTURING PROCESSES I – TIE 3113

FIRST SEMESTER EXAMINATION - FEBRUARY 2010

Instructions

1. Examination length is **3hrs**.
2. Each question carries twenty **(20)** marks and there are six **(6)** questions in total.
3. Attempt the whole of Section A and three questions from Section B.

SECTION A

QUESTION 1

a) A bronze casting took 8 minutes to freeze. Given that C = 1.5 s/m^2 and the volume of the casting is 450 cm^3 determine the surface area of the casting if it is conical in shape. [5]

b) With the aid of neat sketches, explain how centrifugal casting differs from semi-centrifugal casting and centrifuging. [15]

QUESTION 2

A steel plate casting 4 cm x 6 cm x 25 cm is poured in 15 seconds, the effective sprue height is 20 cm, and the gating ratio is 4:3:1. The density of steel is 7.86 g/cm^3 and the casting yield is 70%. The cylindrical tapered sprue is connected to two square runners, and each runner is connected to two gates that have a width two times the height. If the dynamic viscosity of steel is 0.06 g/cm.sec, determine the following:

a) The amount of metal poured (g and cm^3) [3]

b) The pouring rate (g/s and cm^3/s). [3]

c) The choke velocity (cm/s). [2]

d) The choke area and the location of the choke. [4]

e) The dimensions of the sprue base, each runner, and each gate (cm) . [6]

f) The Reynolds number for melt flow in the runners. [2]

SECTION B

QUESTION 3

a) Outline the lost-wax process. [10]

b) Assuming negligible frictional losses, use Bernoulli's theorem and the law of continuity to show that the areas of the top and bottom of the sprue must obey the following relation to avoid air aspiration

$$\frac{A_2}{A_1} = \sqrt{\frac{h_1}{h_2}}$$

where A is cross sectional area and h is melt head. [10]

QUESTION 4

a) What are the typical operations done in a fettling shop? [6]

b) Write short notes on casting design for expendable-mould casting. [6]

c) Describe a process used to heal internal defects and enhance mechanical properties of castings. [8]

QUESTION 5

a) Distinguish chills from risers. [3]

b) Design a cylindrical riser with a height-to-diameter ratio of 2.5 that will compensate for shrinkage in a 10 cm diameter spherical steel casting. [8]

c) Given that steel shrinks by 3% and the efficiency of feeders in sand moulds is about 14%, for the feeder designed in b) above.

i) Calculate amount of metal required to offset solidification shrinkage of the casting. [6]

ii) Estimate the casting yield. [3]

QUESTION 6

a) Write short notes on the following:

i) Pattern allowances. [6]

ii) Porosity. [6]

iii) Mould fill time. [4]

b) What are some of the disadvantages of plaster moulding? [4]

End of Examination