THE UNIVERSITY OF ADELAIDE

DEPARTMENT OF MECHANICAL ENGINEERING

EXAMINATION FOR THE DEGREE OF B.E.

JUNE 2000

MANUFACTURING ENGINEERING 1 [6231]

TIME: THREE HOURS

[Candidates are allowed 10 mins before the examination begins to read the paper, to refer to notes/ books, and to use any type of electronic calculator]

Answer ALL Questions (Note Marks per Question).

1. What are some advantages and disadvantages of powder metallurgy manufacturing processes compared with casting?

What sorts of component can only be produced using powder metallurgical techniques?

For what types of component would casting be the preferred fabrication technique?

[8 Marks]

2. A billet of aluminium 25mm diameter by 38mm high is compressed between parallel platens to a height of 19mm. The initial yield stress is 65.4N/mm^2 and after a 50% reduction the yield stress is 82.7N/mm^2. Estimate the frictionless work done in deforming the material and the mean force which would produce this amount of work.

If μ = 0.14, find the maximum load; note the following equation:

$$P = A.\sigma_y[1 + (\mu.d)/(3.h)];$$ where:

P = total load on anvils, σ_y = current yield stress of billet,

A = current cross-sectional area, μ = coefficient of friction,

d = current diameter of billet, h = current height of billet.

[12 Marks]

Please see next page.

3. A flat rolling operation is being carried out where the initial and final strip thickness's are 3.2mm and 2.5mm respectively. The initial strip width is 250mm, the roll radius is 250mm, the friction pressure contribution at the roll/strip interface is 10% of the homogeneous pressure, and the average plane strain flow stress of the material is 275N/mm^2 . Estimate the roll force and torque. What would be the effect of applying longitudinal tension to the strip?

[14 Marks]

4. A copper wire is annealed at 2.12mm diameter. What is the smallest diameter to which it could theoretically (homogeneously) be drawn in one pass? [Hint: from your notes reference section 4.3.1. (Appendix)].

[6 Marks]

5. For a manufacturing processing operation state the equation relating the total work done to the ideal, frictional and redundant work components. Calculate the force required in direct extrusion of aluminium (average flow stress 200N/mm^2) from a diameter of 150mm to 50mm. Assume that the redundant work is 40% of the ideal (homogeneous) work of deformation and that the friction work is 25% of the total work of deformation.

[13 Marks]

6. Estimate the largest possible extrusion ratio (R) for cold extrusion of 25mm diameter, 3mm wall mild-steel tube (average flow stress 560N/mm^2) in a 10MN press.

[7 Marks]

7. An orthogonal cutting operation is being carried out under the following conditions:

t_o = 0.1mm, t_c = 0.2mm, width of cut = 5mm, V = 2m/s, rake angle = 10^o, F_c = 500N and F_t = 200N. Calculate the percentage of the total energy that is dissipated in the shear plane.

[8 Marks]

Please see next page.

8. Under certain machining conditions the tool life equation is $V.T^{0.2} = 180$. The time taken to change the tool is 10min.

Show that operating at a cutting speed of 90m/min gives higher output than operating at either 120m/min or 60m/min, other cutting conditions remaining constant. [Hint: Consider "average" cutting speed to include tool changing time].

[4 Marks]

9. Utilising the tool life equation $V.T^{0.25} = 100$ find the optimum speed (m/min), and tool life (min) for minimum cost; if: Tool changing cost = $2.00; Tool grinding cost = $7.00; Labour + Overheads cost per min = $0.50.

[8 Marks]

10. Compare and contrast EDM and ECM with respect to:

principle of operation and applications.

[6 Marks]

11. What are the similarities and differences between consumable and non-consumable electrode welding processes.

Describe the characteristics of the consumable electrode(s) which are used for Metal Arc Welding (MAW), and Gas Metal Arc Welding (GMAW) processes.

[14 Marks]