THE OPEN UNIVERSITY OF SRI LANKA

FACULTY OF ENGINEERING TECHNOLOGY

DIPLOMA OF TECHNOLOGY – LEVEL 04 040

FINAL EXAMINATION – 2006/2007

MEX 4230 / MED 2201 – PRODUCTION TECHNOLOGY-PART B

DATE : ***MARCH 02, 2007***

TIME : ***1015 HRS. – 1230 HRS.***

DURATION : ***2 HOURS 15 MINUTES***

Answer five questions only.

Question 01

(1.1) Explain the term 'traceability' with reference to calibration of measuring instruments and diagrammatically represent the traceability hierarchy of standards.

(1.2) Giving suitable examples, explain the types of measurement errors encountered when taking measurements. How would you propose to eliminate or minimize these errors?

(1.3) 'Variance' is an important characteristic that one should be aware of in selecting an appropriate instrument for measurement. Explain how you would select an instrument for a particular measurement based on variance.

Question 02

(2.1) Explain the degrees of interchangeability available for a fit of components.

(2.2) The fit of a pair of mating components is given by the expression 50 H8/g7. What information can you extract from the above expression?

(2.3) In a limit system of fits the following specifications are given for a hole and shaft having nominal diameters of 35mm.

Hole $35^{+0.020}_{+0.000}$ *mm*

Shaft $35^{-0.002}_{-0.010}$ *mm*

Determine the following,

(i) The type of fit.

(ii) The system of fit

*(iii)*Hole and Shaft tolerances

(iv) Type of tolerance for hole and shaft

(v) The maximum and minimum value of the fit

(Note: Justify your answers whenever appropriate)

Question 03

(3.1) various types of gears are found in power transmission applications. Explain the common methods employed in classifying gears and give suitable examples for each of the methods.

(3.2) Using neat sketches, describe the following parameters associated with gear wheels.

(i) Addendum

(ii) Dedendum

(iii) Base circle

(iv) Diametral pitch

(v) Module

(3.3) A gear wheel of module 2 has 30 teeth. Find the following parameters.

(i) Pitch circle diameter

(ii) Addendum

(iii) Dedendum

(iv) Tooth height

(v) Outside diameter

(3.4) What advantages does gear hobbing method offer over gear forming?.

Question 04

(4.1) Discuss taking suitable examples, the classification of metal cutting processes. Also, state the basis on which the above classification is made.

(4.2) Since various types of chips are formed during metal cutting processes, having an understanding about chip formation plays a significant role in analyzing metal cutting and designing of machine tools. Explain.

(4.3) Using the idealized chip formation model, elaborate the effect of shear plane angle (Φ) on the chip thickness. State any assumptions you make.

Question 05

(5.1) Discuss the importance of studying the forces involved in metal cutting.

(5.2) Using Ernest and Merchant's force diagram, show that the cutting force F_c is given by,

$$\frac{\tau_s A_c \cos(\beta-\gamma)}{\cos[\phi+(\beta-\gamma)]\sin\phi}$$

where,

τ_s - apparent shear strength of the work-piece material

A_c - area of chip before removal

β - mean friction angle on the tool face

γ - rake angle of the tool

ϕ - shear angle

State any assumptions you make during the derivation of the above expression.

(5.3) Obtain an expression for the shear plane angle (Φ), if the work done during cutting is minimum.

Question 06

(6.1) What are the effects of heat generation during metal cutting operations?

(6.2) Show that the temperature in the chip due to shear is given by,

$$\theta_s = \frac{0.9 F_s V_s}{\rho t_0 V_c w C} + \theta_r$$

Where,

θ_s – chip temp.
F_s – force in shear plane
V_s – velocity in shear plane
V_c – cutting velocity
t_0 – uncut chip thickness
w – width of cut
C – specific heat capacity of work-piece materail
θ_r – ambient temp
ρ - density of work-piece material

NOTE: In derivation of the above expression, it is assumed that 90% of the heat generated is carried away with the chip.

(6.3) The following data was collected for a metal cutting operation.

Tool rake angle – 10 degrees

Yield strength of work-piece material – 200 N/mm^2

Un-deformed chip thickness – 0.1 mm

Depth of cut – 2.0 mm

Chip thickness ratio – 0.25 mm

Cutting speed – 6.0×10^{-2} m/min

Density of work-piece material – 6000 kg/m

Specific heat of work-piece material – 500 J/kgK

Room temp. – 20 ^{0}C

Find the temperature in chip due to shear, assuming that 90% of the heat generated is carried away by the chip.

Question 07

(7.1) Explain the behavior of flow stress (σ_f), during clod working and hot working processes. Also, give examples for cold and hot working processes.

(7.2) Explain the methods available for analyzing stress and strains in metal forming processes.

(7.3) Using any one of the methods described in question (7.2), find the pressure required for an open die forging operation involving a rectangular work-piece. State any assumption you make.

Question 08

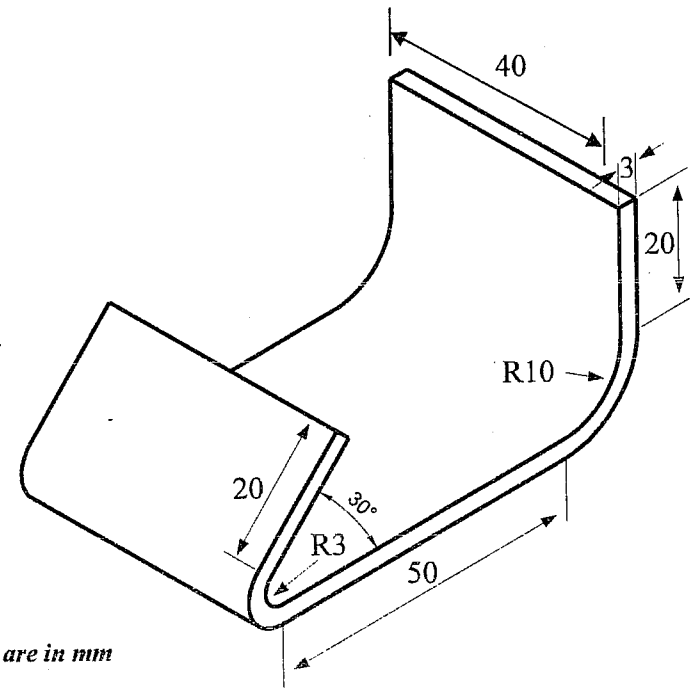
(8.1) Explain the influence of clearance between the blades on the produced work-piece, in a shearing process. Clearly draw sketches of the edges of the sheared work-pieces under,

(i) insufficient
(ii) excessive
(iii) optimum

Clearance conditions. Also, identify the salient features of the cut edges.

(8.2) Crushing and spring-back are two undesirable effects encountered during bending process. Explain these two effects and indicate how these could be minimized.

(8.3) The part shown in figure 8.1 is made out a sheet having a thickness of 3 mm. Find the required length of the strip.



All dimensions are in mm

Figure 8-1

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