THE OPEN UNIVERSITY OF SRI LANKA

FACULTY OF ENGINEERING TECHNOLOGY

DIPLOMA IN TECHNOLOGY – LEVEL 04

FINAL EXAMINATION – 2008/2009

MEX4230 – PRODUCTION TECHNOLOGY

DATE : *MARCH 08, 2009*

TIME : *0930 HRS. – 1230 HRS.*

DURATION : *3 HOURS*

Answer five questions only.

Question 01

(1.1) Define 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) A 41 piece slip gauge set consists of the following sizes of gauges

Size (mm)	Increment (mm)	Number of pieces
1.001 – 1.009	0.001	09
1.01 – 1.09	0.01	09
1.1 – 1.9	0.1	09
1.0 – 9.0	1.0	09
10 - 30	10	03
60	-	01
100	-	01

Build up the best combination for 39.641 mm and find the minimum number of gauges needed to build the above combination.

Question 02

(2.1) Explain the primary objectives of interchangeability in mass production of a particular product or component.

(2.2) Explain the types of fit systems available for obtaining a class of fit. State clearly, under what circumstances each system is used.

(2.3) The maximum and minimum clearances for a hole and shaft with a basic size of 50mm are 0.05mm and 0.01mm respectively. The shaft tolerance is one third that of

the hole tolerance. Calculate the limit size for both hole and the shaft, adopting the systems explained in question 2.2.

Question 03

(3.1) Explain the significant differences between cold working and hot working.

(3.2) Explain the effects of cold working and hot working on strength and ductility of a material. Also, give examples for cold and hot working processes.

(3.3) Explain the law obeyed during the phenomena of strain-hardening, describing all parameters in the governing relationship.

Question 04

(4.1) Differentiate between orthogonal and oblique cutting. Support your answer by giving examples.

(4.2) Using Merchants analysis of the forces acting in orthogonal cutting, show that the force component (Fc) acting in the direction of tool motion relative to the work piece is given by the expression,

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

Where

τ_s = apprent shear streangth of the metal

A_c = area of chip before removal

β = main friction angle on tool face

γ = rake angle of the tool

ϕ = angle of shear plane

Also show that the minimum angle of shear plane (ϕ) is given by,

$$\phi = \frac{\pi}{4} - \frac{(\beta - \gamma)}{2}$$

(4.3) A metal cutting test was conducted on a lathe and the following data were obtained,

Tensile load on tool	= 2500 N
Depth of cut	= 3mm
Feed rate	= 0.15 mm/rev
Cutting speed	= 30 m/min

Determine:

(a) The pressure in N/mm^2 of the chip cross-sectional area on the load.

(b) The efficiency of the machine tool if the input to the driving motor was 3.75 kW and its efficiency being 80%.

Question 05

(5.1) Distinguish between Bulk deformation processes and Sheet metal processes and give at least three examples for each process.

(5.2) Spring back effect is commonly encountered in bending processes.

(i) Explain the phenomenon of spring-back.

(ii) Briefly explain the way in which spring-back can be minimized.

(5.3) *Clearance between the blades of a shearing machine plays a significant role in shearing process of metal sheets.* Explain with neat sketches, the consequences of incorrect clearance during the shearing process.

Question 06

(6.1) What are the different types of tool wear?

(6.2) Draw a typical curve of tool wear against tool life and briefly explain each region of the curve.

(6.3) A carbide tool was found to give a life of 2 hours when machining a piece of mild steel at 50 m/min. Calculate the tool life, if the same loading conditions are used at a speed, 30% higher than the pervious speed. Also determine the cutting speed if the tool is required to have a tool life of 3 hours. Assume cutting tool index n ; 0.25

Question 07

(7.1) Explain the main zones in which heat is generated during metal cutting processes. Represent these zones neatly on a diagram

(7.2) 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 temperature

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 material

θ_r – ambient temperature

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.

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

Tool rake angle – 15 degrees

Yield strength of work-piece material – 208 N/mm^2

Un-deformed chip thickness – 0.1 mm

Depth of cut – 2.0 mm

Chip thickness ratio – 0.25

Cutting speed – 6.2×10^{-2} m/min

Density of work-piece material – 6500 kg/m

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

Room temperature – 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 08

(8.1) Briefly explain the machine tools available under the classifications of 'degree of accuracy'.

(8.2) What advantages do welded machine beds offer over cast machine beds?

(8.3) What are the advantages of having ribs in machine tool beds?

(8.4) Briefly explain the main types of spindle speed variations found in machine tools.