

[This question paper contains 4 printed pages.]

Your Roll No. ....

3196

Relationship

J

MEM (PE)

Paper—ME.604

## THEORY OF METAL CUTTING

Time : 3 Hours

Maximum Marks : 100

(Write your Roll No. on the top immediately  
on receipt of this question paper.)

Attempt any five questions.

All questions carry equal marks.

1. (a) How do you differentiate between orthogonal cutting and oblique cutting? Explain Lee and Shaffer's slip line method of determining shear plane angle. 10
- (b) In an orthogonal cutting test on a m.s. tube of size 150 mm diameter and 2.1 mm thickness, conducted at 90 metre per minute and 0.21 mm/rev. feed, the following data were recorded :
 

Cutting force	= 1250 N
Feed force	= 300 N
Chip thickness	= 0.3 mm
Contact length	= 0.75 mm
Net horse power	= 2 kW
Back rake angle	= $-10^\circ$

- Compute shear strain, strain energy per unit volume. 10
2. (a) Describe a method of determining specific cutting resistance in turning operation. Derive its relationship. 10
- (b) An aluminium alloy bar of 80 mm diameter is turned on a lathe at a cutting speed of 60 m/min. The feed and depth of cut are set at 0.4 mm/rev and 3.5 mm respectively. The cutting force component is observed to be 750 N. Determine the specific cutting resistance and unit power for the material. 10
3. (a) List various methods of determining tool chip contact temperature. Describe temperature measuring technique using tiny thermocouples embedded in the tool in metal cutting. 10
- (b) Determine the temperature rise at the shear plane from the following experimental data in orthogonal cutting of mild steel of density  $7.87 \text{ gm/cm}^3$  and specific heat of  $0.44 \text{ J/gm}$  take  $\lambda = 1$ . 10
- Cutting force component  $F_C = 1600 \text{ N}$   
 Thrust component  $F_T = 500 \text{ N}$   
 Depth of cut = 0.3 mm  
 Width of cut = 5 mm  
 Chip thickness ratio = 0.42  
 Tool rake angle =  $10^\circ$   
 Cutting velocity = 35 m/min.

4. (a) What is a cutting fluid? Mention the requirements of a cutting fluid. How does it improve the tool life? (i) 10
- (b) What are the main groups of the cutting fluids? Under what circumstances would you recommend the use of the cutting fluids as listed below?
- (i) Extreme pressure emulsion
  - (ii) Chemical coolant
  - (iii) Liquid carbon dioxide
  - (iv) Compressed air
  - (v) Straight mineral oil. 10
5. (a) What is the working principle of electric discharge diamond grinding (EDDG)? Explain it with neat sketch. 10
- (b) Briefly describe the working principle of laser beam machining (LBM) with neat sketch. Explain the production of lasers. 10
6. (a) Explain the principle and working of electrochemical machining (ECM). How do we calculate material removal rate in ECM? List the assumptions made. 10
- (b) Make a schematic diagram of magnetic abrasive finishing (MAF) of internal surface of a cylinder showing lines of magnetic force, magnetic equipotential lines, direction of rotary motion. 10

7. (a) Discuss the different mechanisms of tools wear.

Explain following kinds of tool damage :

(i) Flank wear

(ii) Crater wear

(iii) Chipping 10

(b) Define tool life. Enumerate the factors affecting tool life. Describe the importance of life testing of cutting tools. 10