[This question paper contains 5 printed pages.]

3088 *Your Roll No.* ....

MEM (PE) **J**

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.*
Assume missing data, if any.

1. (a) Define the term "Machining". Describe various types of chips formed in metal cutting. Explain an experimental method of determining shear plane angle. (7)

   (b) How is the cutting force in orthogonal cutting affected by : (7)

   (i) Rapee angle

   (ii) Cutting speed

   (iii) Feed

   (iv) Depth of cut

   Explain the effect of these parameters on shear plane angle also.

(c) What is the principle of merchant's model for determining shear plane angle in orthogonal cutting ? Derive the relation for average coefficient of friction between the chip and the tool. (6)

2. (a) What are ploughing forces ? How are they determined ? (6)

(b) In an orthogonal cutting test on a m.s. tube of size 150 mm diameter and 2.1 mm thickness, conducted 90 m/min 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	= −10°

Compute Shear strain and strain energy per unit volume. (7)

(c) Describe a method of determining specific cutting resistance in turning operation. (7)

3. (a) Name several techniques for determining tool chip contact temperature. Describe the infrared photographic technique of measuring temperatures in metal cutting. (7)

(b) Determine the temperature rise at the shear plane from the following experimental data in orthogonal cutting of mild steel of density 7.87 gm/cm^3 and specific heat of 0.44 j/gm taking that $\lambda = 1$.

Force component in the direction of cutting velocity $F_n = 1600$ N

Force component normal to machine surface $F_v = 500$ N

Depth of cut	= 0.3 mm
Width of cut	= 5.0 mm
Chip thickness ratio	= 0.42
Tool rake angle	= 10°
Cutting velocity	= 35 m/min

(7)

(c) Name different types of cutting fluids used in metal cutting. How does the method of application affect the effectiveness of the cutting fluid ? (6)

4. (a) Discuss the different mechanisms of tool wear. Explain comparative performance of HSS, carbides and oxides against flank wear, crater wear and chipping. (7)

(b) What is the importance of life testing of cutting tools ? Enumerate and classify the different types of tool life tests. (7)

(c) What do you understand by economics of metal cutting ? Derive the relationship for optimum cutting speed for maximum production rate. (6)

5. (a) Explain the working principle of AJM process with a schematic diagram with the help of sketches, show the effect of stand-off distance on

(i) Width of cut

(ii) Material removal rate (7)

(b) With the help of a neat diagram, explain the working principle of abrasive flow machining process. Write salient feature of AFM system. Detail the important process variables and responses. (7)

(c) Briefly discuss about abrasive water jet machining (AWJM). Write the difference between WJM, AJM and AWJM processes from the view point of working principle, application & limitations. (6)

6. (a) With the help of neat sketch, explain the mechanism of material removal in EDM. Sketch the effect of following parameters on MRR during EDM :

(i) Resistance (ii) Current density

(iii) Pulsed energy (iv) Capacitance (7)

(b) Explain the production of laser beam and working principle of LBM. (7)

(c) Describe the working principle of electron beam machining (EBM) process. Write an equation to compute specific energy of vaporization. (6)

(a) Describe with neat sketch, the working principle of ECM process. How is the machining rate affected by

(i) Electrolyte flow rate

(ii) Electrolyte temperature

(iii) Applied voltage between tool & work piece (7)

(b) Explain the mechanism of material removal in electrochemical grinding (ECG) process. How it is different from ECM ? (7)

(c) Describe the working principle of VSM. Explain throwing and hammering mechanisms for volumetric material removal. (6)