Time: 3 Hours **Total Marks: 80**

Note: (1) **Question No. 1** is compulsory
(2) Attempt **any three** questions out of the remaining five questions.
(3) Assume suitable data wherever necessary and justify it.
(4) Figures to the right indicates full marks.

Q1. Answer the following questions.(**Any four**) **20**

(a) What do you understand by surface finish? Explain the factors which affect surface finish.

(b) Sketch a plain milling cutter and explain various elements of it.

(c) Write a short note on measurement of chip tool interface temperature.

(d) What is mean by solid, mechanically regrindable and throw away type of cutting tools?

(e) Explain flank and crater wear mechanism in case of cutting tool.

(f) With the help of Merchant's circle diagram explain the relationships between various forces of orthogonal cutting.

Q2. **(a)** In an orthogonal turning operation following data was obtained. **12**
Cutting force: 120 kg, Feed force: 30 kg, Rake angle: 10°
Feed: 0.2 mm/ rev, Width of cut: 2.3 mm, chip thickness: 0.4 mm and cutting speed: 120 m/min.
Determine the following:
Chip thickness ratio, shear angle and friction angle, shear stress and normal stress on shear plane, shear velocity and chip flow velocity, shear strain in the chip and specific cutting energy.

(b) List the major requirements of cutting tool material. Explain general properties, composition, types and applications of high speed steel and carbides as cutting tool material. **8**

Q3. **(a)** What do you understand by form tools? Explain how to calculate profile depth of flat form tool by analytically and graphically. **10**

(b) Explain the various sources of heat generation in metal cutting. **6**

(c) Define machinability and machinability index. Also state the factors affecting machinability. **4**

Q4. **(a)** How single point cutting tools are designated in MRS and ORS? Explain how rake and clearance angles are converted from MRS to ORS by master line method. **10**

(b) Derive an expression for modified Merchant's orthogonal cutting model which considers the effect on normal stress on shear plane. **10**

Q5. **(a)** During turning operation of a steel rod of 80 cm long and 10 cm in diameter on a lathe with a depth of cut of 5 mm and feed of 0.4 mm/rev, the following date was obtained. **10**

(I) Two types of carbide tools were used, the details of which are given below.

Tool material	Tool cost	Tool changing time
Brazed tool inserts	Rs. 30 per cutting edge	2 minutes
Throw away type inserts	Rs. 20 per cutting edge	0.5 minutes

(ii) Both the tool material follows the tool life equation $VT^{0.3}=60$

(iii) Machine labor cost is Rs. 6 per minute.

Based on minimum cost of production criterion, suggest which material is economical.

(b) Discuss cutting fluids with their properties, types and applications. **6**

(c) Write a short note on surface roughness measurement. **4**

Q.6 **(a)** Explain the step by step by procedure involved in the design circular broach tool. **10**

(b) Attempt the following questions. **(Any Two)** **10**

i. Explain how tool shank is designed from strength and rigidity considerations.

ii. Explain briefly ISO coding system used for tipped tools and tool holders.

iii. What is dynamometer? State various dynamometers used for cutting force measurement and explain any one briefly.

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