

**BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING) - FOURTH YEAR
FIRST SEMESTER (OLD), 2019
MACHINE TOOLS**

Time: 3 hour

Full Marks: 100

Answer any *five* questions.
Assume relevant data if necessary.

1. a) Prove that in metal cutting

i)
$$\xi = \frac{\cos(\beta - \gamma_0)}{\sin\beta}$$

ii)
$$\epsilon = \frac{\xi^2 - 2\xi\sin\gamma_0 + 1}{\xi\cos\gamma_0}$$
 (The symbols carry usual meaning).

- b) Show that the cutting velocity is always greater than chip velocity during metal cutting.
- c) What are orthogonal cutting and oblique cutting? State the conditions for them.

7 + 5 + 8

2. a) Determine orthogonal rake angle and inclination angle of a turning tool whose geometry is given as $8^\circ-10^\circ-8^\circ-8^\circ-25^\circ-30^\circ-0$ mm (ASA). Also sketch the sectional views to show the different angles of this tool. What is master line for rake surface?
- b) Discuss how principal cutting edge angle and auxiliary cutting edge angle of a single point turning tool are selected.
- c) What are the effects of nose radius of a single point turning tool?

10 + 6 + 4

3. a) For a cutting tool the following observations have been made:

| | | |
|-----------|----|----|
| V (m/min) | 25 | 35 |
| T (min) | 90 | 20 |

where V= cutting speed, T= tool life.

Recommend the cutting speed for a desired tool life of 60 min.

- b) Discuss the essential properties of a cutting fluid.
- c) What are the common cutting fluids?

7 + 8 + 5

4. a) During an orthogonal cutting the following data were obtained:

Chip thickness= 0.45 mm,

Width of cut= 2 mm,

Feed= 0.25 mm/rev,

Tangential component of cutting force= 1130 N,

Thrust force= 295 N,

[Turn over

Cutting speed= 150 m/min

Rake angle= 10°

Calculate the shear force and coefficient of friction at chip tool interface.

- b) Derive Merchant's first solution for shear angle relationship. **10 + 10**
5. a) What is differential mechanism? Explain its use in a lathe for pitch error correction during thread cutting.
- b) What is compliance of a machine tool? Derive an expression for compliance of a centre lathe **10 + 10**
6. Derive the expressions for optimum cutting speed and feed for minimum cost. Also explain the selection of cutting speed and feed combination. **20**
7. a) What are the requirements of a machine tool dynamometer?
- b) Derive an expression of average shear plane temperature in metal cutting.
- c) State the assumptions made for Merchant's Circle Diagram. **7 + 8 + 5**
8. Write short notes on any *four*: **4 x 5**
- a) Sources of machine tool vibration.
- b) Z-Z method of application of cutting fluid.
- c) Measurement of shear angle
- d) Cantilever type dynamometer.
- e) Standard values of ϕ
- f) Determination of coefficient of friction at chip tool interface.
- g) Adhesion wear
- h) Continuous chips with BUE.