Ref. No.: Ex/ME/5/T/511/2019

BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING) FIFTH YEAR
FIRST SEMESTER - 2019

METAL CUTTING AND 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) $\varepsilon = \frac{\xi^2 - 2\xi\sin\gamma_0 + 1}{\xi\cos\gamma_0}$ (The symbols carry usual meaning).

   b) In metal cutting establish a relationship between the chip velocity, cutting velocity and the velocity along shear plane.

   c) Discuss about the different types of chips in metal cutting. **7 + 5 + 8**

2. a) In an orthogonal cutting of steel with carbide tool, the following data was obtained:
   Tool rake angle= 15^0
   The width of cut= 1.2 mm
   Chip thickness ratio= 0.35
   Cutting force= 800 N
   Thrust force= 400 N
   Estimate the shear angle and other force components.

   b) Derive the Merchant's second solution for shear angle relationship. State the draw backs of the first solution. **10 + 10**

3. a) The tool life of a cutting tool varies with a cutting speed as shown below:

Cutting speed (m/min)	Tool life (min)
120	110
150	37

   Estimate the cutting speed to obtain a tool life of 60 min.

   b) Explain the adhesion wear and diffusion wear of cutting tool material.

   c) Write the modified Taylor's tool life equation and explain it. **7 + 9 +4**

4. a) Explain the general requirement of machine tool dynamometer.

   b) Neatly sketch a cantilever type dynamometer to be used for turning operation and explain it.

   c) Deduce an expression for average shear plane temperature in metal cutting. **6 + 8 + 6**

[Turn over

5. Design a 12 speed gear box having maximum rpm= 360 and minimum rpm= 20. The common ratio is 1.25. The hp of the motor is 10. **20**

6. a) What is differential mechanism? Explain its use in machine tools.
   b) Derive an expression for compliance of a centre lathe. **10 + 10**

7. Derive the expressions for optimum cutting speed and feed for minimum cost. Also explain the selection of cutting speed and feed combination. **20**

8. a) What are C22 and K23 structure of machine tool? Sketch them.
   b) What are the functions of cutting fluid? Discuss in detail.
   c) Explain mist cooling and Z-Z method of cutting fluid application. **5 + 9 + 6**

9. Write short notes on any ***four***: **4 X 5**

   a) Tool geometry of SPTT in ASA
   b) Open loop system in NC machine tool
   c) Types of cutting fluid
   d) Measurement of shear angle
   e) Advantages and disadvantages of CNC machine tool
   f) Co-ordinate system in CNC machine tool
   g) Orthogonal cutting and oblique cutting