30

Ref. No.: ME/5/T/414/2017(S)

B. MECHANICAL (EVEENING) 4TH YEAR 1ST SEMESTER SUPPLE. EXAMINATION, 2017

MACHINE TOOLS

Time: **Three Hours** Full Marks: **100**

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

1. a) Write the tool signature of a single point turning tool in ASA and draw the views to show all the relevant features of it.
   b) For a single point turning tool, the back rake angle is 8^0 and the side rake angle is 10^0. Find the orthogonal rake angle and the inclination angle of it.
   c) Derive the relationship used for the above question 1.(b). **8 + 5 + 7**

2. a) State the assumptions for developing Merchant's Circle Diagram. Derive the expressions for the friction force, normal force at the chip-tool interface, shear force and the normal force at shear plane in terms of the cutting and the thrust components of the machining force with the help of Merchant's Circle Diagram..
   b) The cutting and the thrust components of the machining force during orthogonal machining of aluminium with rake angle of 10^0 are found to be 312 N and 185 N, respectively.
      i) Estimate the coefficient of friction between the tool and the chip.
      ii) If the rake angle is reduced to 0^0, keeping all other parameters same, and if the coefficient of friction also remains unchanged, estimate the new values of the cutting and the thrust components of the machining force, using Merchant's first solution. **10 + 10**

3. a) What is Merchant's second solution for relationship between the angles in metal cutting? Derive the expression in terms of Machining Constant. Also explain the same.
   b) How is the shear angle measured experimentally? Explain it with necessary sketch(es).
   c) The chips from an orthogonal cutting operation with an uncut thickness of 0.2 mm for various rake angles are:

Rake angle	15^0	10^0	5^0	0^0
Chip thickness (mm)	0.45	0.5	0.63	1.13

   Calculate, for each chip, the corresponding shear angle and shear strain and plot them against the rake angle. **9 + 5 +6**

4. a) Showing the locations of the strain gauges, explain how the cantilever beam type dynamometer can be used to measure the cutting and the thrust components of the machining force in turning operation.

b) Derive the expression for the average shear plane temperature in metal cutting operation.

c) Discuss the different factors affecting the cutting temperature during metal cutting. **7 + 6 + 7**

5. a) Discuss the essential properties of a cutting fluid.
   b) Explain the method of Z-Z cooling.
   c) State and explain the different methods of tool failure through gradual wear. **7 + 4 + 9**

6. a) Derive and discuss the conditions for best ray diagram in designing a speed gear box of a machine tool.
   b) A centre lathe is to be used to machine ms and cast iron bars of diameters 25 mm to 75 mm with hss and carbide tools. Calculate all the spindle speeds considering GP series of speed variation. Draw a possible ray diagram. **10 + 10**

7. a) What is the static compliance of a machine tool? Derive an expression for the static compliance of a centre lathe.
   b) What is differential mechanism? Discuss the working of any one differential mechanism used in machine tool.
   c) Show that the value of the ratio between two consecutive speeds of a machine tool lies between 1 and 2. **10 + 6 + 4**

8. a) Derive an expression for optimum cutting speed for minimum cost in machining
   b) Prove that the average speed loss w.r.t. mean speed is $(\emptyset-1)/(\emptyset+1)$. **16 + 4**

9. Write short notes on (any **four**): **5 X 4**
   i) Requirements of a dynamometer
   ii) Temperature distribution as developed by Boothroyd
   iii) Formative motions
   iv) Continuous chips with BUE
   v) Orthogonal cutting and oblique cutting
   vi) Selection of nose radius and principal cutting edge angle of cutting tool.