Ref. No.: **ME/T/413/2017(S)**

B. MECHANICAL 4TH YR. 1ST SEM. SUPPLE. EXAMINATION, 2017

MACHINE TOOLS

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

Answer any ***five*** questions.
Assume relevant data if necessary.
The notations used in the questions carry usual meaning.

1. a) Write the tool signature of a single point turning tool in ASA and sketch the sectional views of the tool to show all the relevant features of it.
   b) What is master line for rake surface? Deduce an expression of $\tan\gamma_x$ in terms of λ, γ_0 and $\emptyset$.
   c) Why is nose radius provided on single point turning tool? **8 + 9 + 3**

2. a) Prove the following:
   i) $\xi = \frac{\cos(\beta - \gamma_0)}{\sin\beta}$
   ii) $\varepsilon = \frac{\xi^2 - 2\xi\sin\gamma_0 + 1}{\xi\cos\gamma_0}$
   b) Establish the relationship among the cutting velocity, chip flow velocity and velocity of shear in metal cutting.
   c) In orthogonal turning of a mild steel bar of 60 mm diameter on a lathe a feed of 0.8 mm/rev is used. The principal cutting edge angle of the turning tool is 90^0. A continuous chip of 1.4 mm thickness is removed at a rotational speed of 75 rpm of the job. Calculate the chip reduction coefficient and total length of the chip in 30 s. **8 + 6 + 6**

3. 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) Results obtained during orthogonal machining of steel with a single point cutting tool of rake angle 10^0 are:
   thickness of cut chip= 1.4 mm
   tangential component of cutting force=975 N
   thrust component of cutting force= 450 N
   uncut chip thickness= 0.6 mm
   width of cut= 1.7 mm.
   Determine the friction force at the chip-tool interface and shear strength of the material. **10 + 10**

4. a) State the effects of heat generated during metal cutting. Also show the distribution of heat generated.

[Turn over

b) State the purposes of use of cutting fluid in machining and grinding operations. For cutting steel, select the cutting fluids.
c) What are the required properties of an ideal tool material? Explain them. **6 + 8 + 6**

5. a) Define tool life. Explain how Taylor's tool life equation is developed. How does the tool life depend on feed and depth of cut?
b) During machining of mild steel, for tool X the tool life equation is $VT^{0.12} = 60$ and for tool Y it is $VT^{0.22} = 80$. Evaluate the break-even speed above which tool Y will give better tool life? **10 + 10**

6. 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 Merchant's first solution for shear angle relationship.
c) Show that for speed layout in machine tools $1 < \varphi \leq 2$. **6 + 9 + 5**

7. a) Explain unilateral and bilateral structure diagram for gear box design in machine tool.
b) Discuss about the selection criteria for best ray diagram.
c) A lathe has 12 speed gear box. The cutting velocity ranges from 40 m/min to 200 m/min while the diameter ranges from 50 mm to 200 mm. Find the values of those 12 speeds. Also select the best ray diagram. **4 + 6 + 10**

8. a) A thread having a pitch of 2.15 mm is to be cut with a single point thread cutting tool on lathe provided with a differential nut mechanism for pitch error correction. The lead of the lead screw is 10 mm. Calculate the change gears and the inclination of the swivel guide in order to cut the above thread. The pinion has 20 teeth and the module is 2 mm.
b) During compliance test of a centre lathe, the work piece is held in between a four jaw chuck and a tailstock centre. The following observations are made in relation to overall compliance of the centre lathe:

When the turning tool is very close to the chuck, the overall compliance is 30 micron/100 kg

When the turning tool is very close to the tailstock centre, the overall compliance is 50 micron/100 kg

When the turning tool is at the middle of the job, the overall compliance is 25 micron/100 kg.

Calculate the individual component compliances of the tailstock, headstock and saddle element. **10 + 10**

b) Machine tool chatter
c) Z-Z cooling method
d) Various costs involved in metal cutting and their variation with cutting speed
e) Types of tool wear
f) Orthogonal and oblique cutting.