MACHINING PRINCIPLE & MACHINE TOOLS
(MECH 3202)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) Side rake of turning tool is measured on its
   (a) machine longitudinal plane   (b) machine transverse plane
   (c) orthogonal plane   (d) cutting plane.

   (ii) Rake angle of a twist drill is
   (a) constant along the cutting edge
   (b) increases from centre to outer diameter
   (c) decreases from centre to outer diameter
   (d) none of these.

   (iii) Orthogonal cutting is obtained by a tool having
   (a) inclination angle (λ) positive
   (b) inclination angle (λ) zero
   (c) inclination angle (λ) negative
   (d) principal cutting edge angle (Φ) 90°.

   (iv) A cutting tool can never have its
   (a) rake angle – positive   (b) rake angle – negative
   (c) clearance angle – positive   (d) clearance angle – negative.

   (v) Cutting fluid is used for,
   (a) cooling the workpiece
   (b) cooling the tool
   (c) reducing the friction between chip and tool
   (d) all of these.

   (vi) Life of any cutting tool depends on
   (a) tool material   (b) tool geometry
   (c) application of cutting fluid   (d) all of these.

   (vii) In metal cutting operation, maximum heat is generated in
   (a) chip-tool interface zone   (b) shear zone
   (c) tool-work interface zone   (d) none of these.

   (viii) If all the kinematic chains are interconnected (or interdependent) in any machine tool then its kinematic structure will be called
   (a) elementary type   (b) complex type
   (c) compound type   (d) combination type.

   (ix) Tool life of a turning tool is estimated based on,
   (a) crater wear growth   (b) flank wear growth
   (c) plastic deformation   (d) brittle fracture.

   (x) Best Ray diagram is obtained with,
   (a) nodes shifting left
   (b) nodes shifting right
   (c) more no. of speeds in the initial stage
   (d) more no. of speeds in the final stage.

Group – B

2. (a) Define Metal Cutting process. Show with neat sketch different tool angles of a Single point turning tool represented in Orthogonal Rake System (ORS).

   (B) A single-point turning tool is specified in ORS as 5°,10°, 6°, 6°,15°, 75°, 1 mm. Find the Back rake (γ_y) and front rake (γ_x) of the tool using Master line method.

                                        (2 + 6) + 4 = 12

3. (a) During Orthogonal turning of a mild steel rod by a tool having 10° orthogonal rake (γ_o) and 75° principal cutting edge angle (Φ) at feed 0.32 mm/rev, the chip thickness (a_2) was found to be 0.60 mm. Determine (i) chip reduction coefficient (ii) shear angle (iii) shear strain for above machining.

   (b) (i) Differentiate between Orthogonal cutting and Oblique cutting.
   (ii) Discuss on chip formation in Up milling and Down milling with necessary sketches.

                                        6 + (2 + 4) = 12

Group – C

4. (a) State the sources of heat generation in machining. How can machining temperature be controlled? How is a grinding wheel specified?

(b) In orthogonal turning of a steel bar of 100 mm diameter, at a speed of 625 rpm, feed of 0.4 mm/rev by a tool of geometry 0^0 -12^0 6^0 6^0 30^0 60^0 0 (mm), it was observed that P_z = 1200 N, P_x = 400 N and chip thickness a_2 = 1.0 mm. Determine the values of F, N, P_s, P_n and β (symbols are as per convention).

(2 + 3 + 2) + 5 = 12

5. (a) Write the modified Taylor's tool life equation and explain the role of machining process parameters on tool life. Determine the values of the constant C and index n of Taylor's tool life equation if the value of tool life decreased from 40 min to 10 min due to increase in cutting velocity from 80 m/min to 160 m/min in turning mild steel rod by a coated carbide tool insert under a given condition.

(b) Draw a Merchant's circle diagram (MCD) visualizing the various cutting force components that arise during orthogonal turning and also state its advantages and limitations.

(3 + 4) + 5 =12

Group – D

6. (a) Briefly explain gereratrix and directrix, with the help of a suitable diagram. How are shaping machines different from planning machines?

(b) Classify types of machine tool kinematic structures and explain their basic differences using suitable block diagrams.

(4 + 2) + 6 = 12

7. (a) What are the major differences between capstan and turret lathes? Explain Geneva mechanism with suitable diagram and its one use in machine tool.

(b) What are the classifications of lathe? Write down the name of the operations that can be done on lathe machine.

(3 + 3) + (3 + 3) = 12

Group – E

8. (a) Explain with suitable diagram the selection and change of feed in a Centre Lathe.

(b) Define Machinability of a material. Discuss on the factors on which machinability of a material depends.

6 + (2 + 4) = 12

9. (a) A cylindrical job of 100 mm diameter and length of 250 mm has to be turned upto 80 mm diameter with a carbide tool at a cutting speed of 100 m/min and feed of 0.2 mm/rev in a centre lathe. Depth for each pass is 2 mm. Estimate the machining time required for turning the job with an approach and over-travel of 2mm each.

(b) What is Numerical Control? Write down the advantages of using CNC Machine Tool.

6 + (2 + 4) = 12