MACHINING & MACHINE TOOLS
(MECH 3104)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(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) A cutting tool can never have its
(a) Rake angle – positive (b) Rake angle – negative
(c) Clearance angle – positive (d) Clearance angle – negative.

(iii) Formation of built-up-edge in machining
(a) Raises magnitude of cutting forces (b) Reduces tool life
(c) Increases surface roughness (d) All of the above.

(iv) Life of any cutting tool depends on
(a) Tool material (b) Tool geometry
(c) Application of cutting fluid (d) All of these

(v) In metal cutting operation, maximum heat is generated in
(a) Chip-tool interface zone (b) Tool-work interface zone
(c) Shear zone (d) Equal heat for all zones.

(vi) Dividing head is one of the most important attachments used with
(a) Drilling machine (b) Milling machine
(c) Power saw (d) Grinding machine.

(vii) Slotted arm oscillating mechanism is used for transforming rotation into linear motion in
(a) Broaching machine (b) Shaping machine
(c) Planning machine (d) Gear shaping machine.

(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) Use of CNC machine tools are not justifiable for
(a) Piece production (b) Batch production
(c) Small lot production (d) Mass production.

(x) When a grinding wheel becomes blunt after usage for some length of time, it is
(a) replaced
(b) sharpened in another grinding machine
(c) dressed using a diamond tool
(d) chemically treated to regain sharpness.

Fill in the blanks with the correct word

(xi) Primary deformation zone in metal cutting operation is located at _____.

(xii) Machining of mild steel yields _____ type of chip.

(xiii) The diameter of the Merchant's circle diagram represents the magnitude of the _____.

(xiv) During turning operation, the generatrix is obtained by _____ motion.

(xv) The primary function of the speed gearbox is to adjust the _____ of the spindle to accommodate different machining requirements.

Group - B

2. (a) With the help of suitable diagrams prove that $\tan \gamma_y = \tan \gamma_0 \cos \varphi + \tan \lambda \sin \varphi$ where γ_y means back rake angle, γ_0 means orthogonal rake angle, λ means inclination angle and φ means principal cutting edge angle. *[(CO1)(Analyse/IOCQ)]*

(b) State the advantages of rake angle being positive, negative even zero for machining. Why is the clearance angle provided in machining? *[(CO1)(Remember/LOCQ)]*

6 + (4 + 2) = 12

3. (a) Explain the mechanism of chip formation for ductile and brittle materials and the types of chip with suitable diagrams. *[(CO2)(Analyse/IOCQ)]*

(b) Define 'chip reduction coefficient' and 'cutting strain' related to chip thickness and explain why the value of chip reduction coefficient is generally greater than 1.0? *[(CO1)(Remember/LOCQ)]*

(3 + 3) + (4 + 2) = 12

Group - C

4. (a) Draw a Merchant's circle diagram (MCD) visualizing the various cutting force components that arise during orthogonal turning. *[(CO2)(Remember/LOCQ)]*

(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). *[(CO2)(Evaluate/HOCQ)]*

6 + 6 = 12

5. (a) What are the important characteristics of a cutting tool? The following data were obtained while turning a mild steel rod on a lathe: cutting speed = 30 m/min, feed = 0.25 mm/rev., depth of cut = 2.0 mm, tool life = 90 minutes. The following tool life equation is given by the equation $V\ T^{0.12}\ f^{0.7}\ t^{0.3} = C$. If turning speed is increased by 25%, what will be the effect on tool life? *[(CO4)(Evaluate/HOCQ)]*

(b) Discuss the causes, location with suitable diagram and effects of heat generation in machining. *[(CO3)(Understand/LOCQ)]*

6 + 6 = 12

Group - D

6. (a) Apply the concepts of generatrix and directrix for "Turning" and "Drilling" using suitable diagrams. *[(CO5)(Apply/IOCQ)]*

(b) Classify machine tools according to capacity, automation and configuration. *[(CO5)(Understand/LOCQ)]*

6 + 6 = 12

7. (a) Compare between shaping and planning operations. *[(CO5) (Analyse/IOCQ)]*

(b) Explain the mechanism of power transmission from a motor to the spindle of a centre lathe for achieving variable rotational spindle speeds, with a relevant diagram. *[(CO6)(Understand/LOCQ)]*

6 + 6 = 12

Group - E

8. (a) Find the time required on a shaping machine for completing one cut on a plate 200 mm × 300 mm, if the cutting speed is 10 m/min. and feed of 1mm/stroke. The return time to cutting time ratio is 2:3. Assume approach and overrun along width = 2 mm and along length = 5 mm. *[(CO6)(Evaluate/HOCQ)]*

(b) Write two advantages and two limitations of the CNC system. *[(CO6)(Remember/LOCQ)]*

6 + 6 = 12

9. (a) The designation of a grinding wheel is given as 51 A 36 L 5 V 23. State the significance of the various elements of the codes. *[(CO5)(Remember/LOCQ)]*

(b) A drilling machine having nine spindle speeds in GP (geometric progression) is to be designed for drilling holes of diameter in between 6 mm and 30 mm at cutting velocity in between 20 m/min and 50 m/min. Determine the values of all those nine spindle speeds. *[(CO6)(Evaluate/HOCQ)]*

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	56.25	12.5	31.25