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) Length of time (min) required for turning a rod depends upon
(a) spindle speed only (b) tool feed rate only
(c) both speed and feed (d) none of feed and speed.

(ii) The principle cutting edge angle of any turning tool is measured in its
(a) cutting plane (b) orthogonal plane
(c) reference plane (d) normal plane.

(iii) Shear angle in chip formation is the angle of inclination of the shear plane from
(a) tool rake surface (b) clearance surface
(c) finished surface (d) reference surface.

(iv) The component of the cutting force which is used to evaluate the cutting power consumption in straight turning is
(a) Axial component (b) Radial component
(c) Tangential component (d) All of these.

(v) Crater wear occurs in cutting tools at
(a) the rake surface (b) the principal flank
(c) the auxiliary flank (d) all of these.

(vi) The tool angle which causes oblique cutting is
(a) Rake angle (b) Clearance angle
(c) Inclination angle (d) Principal cutting edge angle.

(vii) Turret lathes are
(a) non automatic (b) semi automatic
(c) automatic (d) all of the above as per configuration.

(viii) Merchant's circle diagram is valid for
(a) orthogonal cutting only (b) oblique cutting only
(c) both of the above (d) none of the above.

(ix) 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.

(x) If all the kinematic chains are independent in any machine tool then its kinematic structure will be called
(a) Elementary type (b) Complex type
(c) Compound type (d) Combination type.

Fill in the blanks with the correct word

(xi) The maximum amount of heat that is generated at the cutting zone during machining goes to the _____.

(xii) Taylor's tool life equation is expressed as _____.

(xiii) With the increase in principle cutting edge angle of turning tool, the cutting temperature _____.

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

(xv) If axis of milling cutter is parallel to the ground, it is called _____ milling cutter.

Group - B

2. (a) Explain the importance of providing positive rake angle and negative rake angle in cutting tools during machining with necessary sketches. *[(CO1)(Understand/LOCQ)]*

(b) A mild steel rod was subjected to orthogonal turning at high speed, feed of 0.20 mm/rev by a carbide tool of geometry: 0^0, 10^0, 8^0, 7^0, 15^0, 60^0, 0 (mm). Assuming co-efficient of friction at the chip-tool interface equal to 0.50, determine the values of thickness of chip before cut and shear angle. *[(CO2)(Analyse/HOCQ)]*

6 + 6 = 12

3. (a) Classify the types of chips and also state under what condition of machining those different types of chip form. *[(CO2)(Understand/LOCQ)]*

(b) Define chip reduction coefficient and cutting ratio related to chip thickness and explain why the values of chip reduction coefficient is generally greater than 1.0. *[(CO2)(Apply/IOCQ)]*

6 + (3 + 3) = 12

Group - C

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

(b) How does high cutting temperature affect the cutting tool performance and quality of the machined product? *[(CO3)(Remember/LOCQ)]*

4 + (6 + 2) = 12

5. (a) In an orthogonal turning by a tool having rake angle 12^0 and principal cutting edge angle 60^0, the magnitudes of the cutting force components in tangential direction was found to be 800 N and chip reduction coefficient 3.0. Determine the values of cutting force components in axial and radial directions. *[(CO2)(Analyse/IOCQ)]*

(b) Name the materials which are presently used for making cutting tools or inserts and compare those materials with respect to composition, hardness and applications. *[(CO4)(Remember/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 operation. *[(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) What is the appropriate geometric progression (GP) common ratio for a lathe with 12 spindle speeds, designed to accommodate machining jobs with diameters ranging from 40 mm to 120 mm, while maintaining cutting speeds between 50 m/min and 200 m/min? *[(CO6)(Evaluate/HOCQ)]*

(b) (i) What are the common applications of grinding wheels in various industries?

(ii) What are the key components used to manufacture of grinding wheels? *[(CO6)(Remember/LOCQ)]*

6 + (3 + 3) = 12

9. (a) Determine the actual machining time that will be required to drill a through hole of diameter 20 mm in a 40 mm thick plate at a cutting velocity of 65 m/min and feed of 0.25 mm/rev. by a HSS drill of cone angle of 120^0. Assume approach and over run = 2 mm. *[(CO6)(Create/HOCQ)]*

(b) What are the key differences between CNC (Computer Numerical Control) and NC (Numerical Control) machining systems, and how have these technologies transformed the field of manufacturing? *[(CO6)(Analyse/IOCQ)]*

6 + (3 + 3) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	50	31.25	18.75

Course Outcome (CO):

After the completion of the course students will be able to

CO1 Explain the basic principle and purpose of machining, familiarization with tool geometry and to designate a single point cutting tool.

CO2 Analyze mechanism of machining, mechanics of machining.

CO3 Identify sources and effects of Heat generation in machining and control of cutting temperature.

CO4 Detect tool failure mechanisms, assess tool life and select an appropriate cutting tool material, assessing machinability.

CO5 Identify purpose, general constructional features and kinematic structures of different machine tools, selection of grinding wheels and application

CO6 Carry out the use of different power drives, gear layout, gear box etc., control of speed and feed of machine tools, estimation of machining time, NC & CNC system.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*