

MACHINING & MACHINE TOOLS
(MECH 3104)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one 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) Angle between the rake face and plane perpendicular to rake face is known as
 - (a) side rake angle
 - (b) side relief angle
 - (c) end relief angle
 - (d) back rake angle.
 - (ii) Which of the following assumptions is not valid for a merchant circle diagram?
 - (a) Continuous Chips
 - (b) Discontinuous chips
 - (c) Cutting edge remains sharp
 - (d) No built up edge.
 - (iii) Which component of the cutting force from tool to the job contributes most to the power requirement of the lathe machine during turning operation?
 - (a) Axial force
 - (b) Radial force
 - (c) Tangential force
 - (d) Cannot be identified definitively.
 - (iv) Life of any cutting tool depends upon
 - (a) tool geometry
 - (b) tool material
 - (c) application of cutting fluid
 - (d) all of these
 - (v) Primary deformation zone in metal cutting operation is located at
 - (a) around shear plane
 - (b) tool chip interface
 - (c) tool workpiece interface
 - (d) tool face.
 - (vi) 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.
 - (vii) 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.
 - (viii) 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.

- (ix) Use of CNC machine tools are not justifiable for
(a) piece production (b) batch production
(c) small lot production (d) mass production.
- (x) What speed distribution in the headstock gear box of a conventional lathe is preferred?
(a) Any distribution that matches the cutting speed range
(b) Arithmetic progression
(c) No speed distribution is preferred
(d) Geometric Progression.

Group – B

2. (a) Briefly describe the basic principle of machining. With the help of a suitable diagram, explain the rake angle and clearance angle of any cutting tool in a machining work. [(CO1)(Understand /LOCQ)]
- (b) A single point turning tool is specified in the ORS system as $0^\circ, 10^\circ, 8^\circ, 6^\circ, 15^\circ, 60^\circ, 0$ (mm), and calculates the back rake (γ_y) and side rake (γ_x) angles of the tool. [(CO1)(Evaluate/HOCQ)]
- 6 + 6 = 12**
3. (a) Discuss the factors which are responsible for producing continuous chip formation during machining. What are the causes and effects of formation of Built-Up-Edge (BUE) during machining of ductile materials? [(CO2)(Understand/LOCQ)]
- (b) A mild steel rod is turned at a feed of 0.32 mm/rev by tool of geometry: $0^\circ, 12^\circ, 6^\circ, 6^\circ, 20^\circ, 45^\circ, 0$ (mm) and chip thickness becomes 0.64 mm. Determine the expected values of chip reduction coefficient, thickness of chip before cut, shear angle and average cutting strain. [(CO2)(Evaluate/HOCQ)]
- 6 + 6 = 12**

Group - C

4. (a) Construct a Merchant's Circle Diagram (MCD) visualizing the various cutting force components that arise during orthogonal turning and also state its limitations. [(CO2)(Evaluate/HOCQ)]
- (b) Under a given condition of turning, the tool life was found to decrease from 24 min to 16 min when only the cutting velocity V_c was raised from 200 m/min to 250 m/min. Evaluate what will be the tool life if the cutting velocity is further increased to 300 m/min under the same machining condition? [(CO4)(Evaluate/HOCQ)]
- 6 + 6 = 12**
5. (a) Explain with sketch, crater wear and how it is measured. What factors are likely to give rise to excessive heat during a metal cutting operation? [(CO3)(Analyze/IOCQ)]
- (b) What is meant by machinability and what factors govern machinability characteristics of any work material? [(CO4)(Remember/LOCQ)]
- 6 + 6 = 12**

Group – D

6. (a) Classify machine tool according to degree and type of automation.
 [(C05)(Remember/LOCQ)]
 (b) Illustrate generatrix and directrix for facing operation with a neat sketch.
 [(C05)(Analyse/IOCQ)]
(3 + 3) + (3 + 3) = 12
7. (a) Demonstrate a complex kinematic structure with the help of a neat sketch.
 [(C05)(Remember/LOCQ)]
 (b) Justify the importance of gearing arrangement within the head-stock of all gear lathe with proper diagram.
 [(C05)(Evaluate/IOCQ)]
6 + 6 = 12

Group - E

8. (a) A lathe having 12 spindle speeds has been designed for machining jobs diameter ranging from 40 mm to 120 mm at cutting speed in between 50 m/min and 200 m/min. What should be the lowest and the highest spindle speed of the lathe.
 [(C06)(Analyse/IOCQ)]
 (b) What speed distribution in the headstock gear box of a lathe is preferred, geometric progression or arithmetic progression? What are the reasons for the preference?
 [(C06)(Analyse/IOCQ)]
6 + 6 = 12
9. (a) A workpiece of 300 mm diameter and 600 mm length is to be turned down to 282 mm for the entire length. The feed taken is 1.2 mm/revolution and the cutting speed is 162 m/min. The maximum allowable depth of cut is 4.5 mm. Calculate the following:
 (i) Longitudinal speed of the tool carriage.
 (ii) Material removal rate.
 (iii) Cutting time.
 Assume tool overtravel is 12.0 mm. Neglect tool approach. [(C06)(Evaluate/HOCQ)]
 (b) Differentiate between open and closed loop numerical control with proper diagram.
 [(C06)(Remember/LOCQ)]
6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	31.25	37.5	31.25

Course Outcome (CO):

After the completion of the course students will be able to

CO 1	Explain the basic principle and purpose of machining, familiarization with tool geometry and to designate a single point cutting tool.
CO 2	Analyze mechanism of machining, mechanics of machining.
CO 3	Identify sources and effects of Heat generation in machining and control of cutting temperature.
CO 4	Detect tool failure mechanisms, assess tool life and select an appropriate cutting tool material, assessing machinability.
CO 5	Identify purpose, general constructional features and kinematic structures of different machine tools, selection of grinding wheels and application
CO 6	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.