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 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) Right Hand turning tool performs machining by
(a) moving right to left (b) moving left to right
(c) moving back to front (d) moving front to back.

(ii) The master line of the rake surface of a turning tool becomes parallel with the principle cutting edge, when
(a) Orthogonal rake angle is zero (b) Normal rake angle is zero
(c) Inclination angle is zero (d) Side rake angle is zero.

(iii) Positive inclination angle (λ) of a turning tool,
(a) keeps the chip perpendicular to cutting edge
(b) deviates the chip towards the tool shank
(c) deviates the chip away from the tool shank
(d) none of these.

(iv) In orthogonal turning of a mild steel rod, the chip velocity becomes
(a) Lesser than the cutting velocity (b) Equal to the cutting velocity
(c) Greater than the cutting velocity (d) Any of the above.

(v) In machining, Merchant circle diagram deals with
(a) surface finish (b) cutting temperature
(c) cutting forces (d) tool life.

(vi) Tool force can be measured by an instrument called,
(a) anemometer (b) dynamometer
(c) extensometer (d) speedometer.

(vii) Generatrix in a Gear Hobbing process is,
(a) Tracing (b) Forming (c) Enveloping (d) Generation.

(viii) Flat surfaces are not produced in
(a) Lathe (b) Drilling machine
(c) Shaping machine (d) Milling machine.

(ix) Both cutting motion and feed motion are imparted to the cutting tool in
(a) Lathe (b) Drilling
(c) Milling machine (d) Shaping machine.

(x) CNC Machine tool has,
(a) open loop control
(b) closed loop position control
(c) closed loop velocity control
(d) closed loop position and velocity control.

Group – B

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

(b) A single-point turning tool is specified in ASA as 10°,12°, 8°, 6°, 15°, 15°, ($^1/_{64}$"). Find the Orthogonal rake (γ_o) and inclination angle (λ) of the tool using Master line method.

(2 + 6) + 4 = 12

3. (a) During orthogonal machining of steel with a tool of ORS geometry, 0°, 10°, 8°, 6°, 15°, 60°, 1 (mm) at a feed of 0.36 mm/rev, the chip thickness was found to be 0.6 mm. Determine (i) chip reduction coefficient, (ii) shear angle and (iii) cutting strain.

(b) Discuss on the types of chips obtained in turning, mentioning the condition at which they are formed. What types of chips are obtained in milling operation?

6 + (4 + 2) = 12

Group – C

4. (a) Draw the Merchant circle diagram of forces and deduce the following relations,
$P_s = P_z \cos\beta_o - P_{xy} \sin\beta_o$ and $P_n = P_z \sin\beta_o + P_{xy} \cos\beta_o$,
where P_s & P_n are shear and normal forces acting at the shear plane P_z & P_{xy} are the component of forces acting on the tool in the orthogonal plane
β_o = shear plane angle

(b) A ductile metal bar of 120 mm diameter is turned at a speed of 320 rpm, feed 0.24 mm/rev and 3mm depth of cut by a tool of the following ORS geometry : 0°, 10°, 8°, 6°, 20°, 70°, 0 (mm) and a chip thickness (a_2) of 0.7 mm is obtained. The following observations were made: Tangential force (P_z) = 750 N; Transverse force (P_y) = 200 N. Determine (i) shear force (ii) normal force at shear plane (iii) Cutting power consumption.

6 + (2 + 2 + 2) = 12

5. (a) What are the different methods of failure of cutting tools? Show with a graph the flank wear growth of a turning tool with machining time. Express Taylor's Tool Life equation mentioning the parameters involved.

   (b) Write down the essential properties of a Tool material used in machining. Discuss on the salient properties of HSS and Cemented Tungsten Carbide as cutting tool materials.

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

Group – D

6. (a) What are the major components of a machine tool? How does drilling machine produce internal cylindrical surface by their tool-work motion as well as generatrix and directrix.

   (b) What are the classification criteria according to degree of automation and type of automation? What are the specifications of a centre lathe?

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

7. (a) Draw the kinematic structure of a centre lathe.

   (b) How would you specify a milling machine? Write down two different operations that can be performed using a milling machine (give necessary sketches).

   (c) Explain how 12 TPI thread can be cut with a 4TPI lead screw in a centre lathe.

3 + (2 + 4) + 3 = 12

Group – E

8. (a) What is machinability? How is it assessed or quantified?

   (b) Describe a Ray diagram mentioning its purpose.

   (c) Explain with the help of a kinematic diagram the feed change system of a Centre Lathe.

(1 + 2) + 3 + 6 = 12

9. (a) Determine the actual machining time required to reduce the diameter of a rod from 200 mm to 150 mm over a length of 200 mm at cutting velocity of 200 m/min and feed of 0.3 mm/rev. Assume approach length of 5 mm and overrun length of 5 mm.

   (b) How is "closed loop control" different from "open loop control"? Explain in reference to numerical control of tool-work motions in machine tools with neat sketch.

6 + 6 = 12

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ME	https://classroom.google.com/c/MzY5NDczMDEwMzUz?cjc=p5u75ui