ASSIGNMENT

Due on 20-01-2025

Assignments submitted after 3:15 am will not be accepted

Answer the short questions

1. What are the parameters of a machining operation that are included within the scope of cutting conditions?
2. Explain the difference between roughing and finishing operations in machining.
3. What is an orthogonal cutting operation?
4. Identify the two forces that can be measured in the orthogonal metal cutting model.
5. What is the specific energy in metal machining?
6. How does a boring operation differ from a turning operation?
7. What is meant by the designation 12 x 36 inch lathe?
8. How does a turret lathe differ from an engine lathe?
9. What is the distinguishing feature of a radial drill press?

Quantitative problems

1. A 6-in. diameter aluminum cylinder 10 in. in length is to have its diameter reduced to 4.5 in. estimate the machining time, if a TiN-coated carbide tool is used. Also find the power for first rough cut.

   Note: use three equal rough cuts and one finished cut

2. In an orthogonal cutting operation, the tool has a rake angle = 15°. The chip thickness before the cut= 0.30 mm and the cut yields a deformed chip thickness = 0.65 mm. Calculate (a) the shear plane angle and (b) the shear strain for the operation.

3. In an orthogonal cutting operation, the 0.250 in wide tool has a rake angle of 5°. The lathe is set so the chip thickness before the cut is 0.010 in. After the cut, the deformed chip thickness is measured to be 0.027 in. Calculate (a) the shear plane angle and (b) the shear strain for the operation.

4. In a turning operation, spindle speed is set to provide a cutting speed of 1.8 m/s. The feed and depth of cut of cut are 0.30 mm and 2.6 mm, respectively. The tool rake angle is 8°. After the cut, the deformed chip thickness is measured to be 0.49 mm. Determine (a) shear plane angle, (b) shear strain, and (c) material removal rate. Use the orthogonal cutting model as an approximation of the turning process.

5. The cutting force and thrust force in an orthogonal cutting operation are 1470 N and 1589 N,
   respectively. The rake angle = 5°, the width of the cut = 5.0 mm, the chip thickness before the cut = 0.6mm, and the chip thickness ratio = 0.38. Determine (a) the shear strength of the work material and (b) the coefficient of friction in the operation.

6. The cutting force and thrust force have been measured in an orthogonal cutting operation to be 300 lb and 291 lb, respectively. The rake angle = 10°, width of cut = 0.200 in, chip thickness before the cut = 0.015, and chip thickness ratio = 0.4. Determine (a) the shear strength of the work material and (b) the coefficient of friction in the operation.

7. The shear strength of a certain work material = 50,000 lb/in2. An orthogonal cutting operation is performed using a tool with a rake angle = 20° at the following cutting conditions: cutting speed = 100 ft/min, chip thickness before the cut = 0.015 in, and width of cut = 0.150 in. The resulting chip thickness ratio = 0.50. Determine (a) the shear plane angle, (b) shear force, (c) cutting force and thrust force, and (d) friction force.

8. In a turning operation on stainless steel with hardness = 200 HB, the cutting speed = 200 m/min, feed = 0.25 mm/rev, and depth of cut = 7.5 mm. How much power will the lathe draw in performing this operation if its mechanical efficiency = 90%. Use Table 21.2 to obtain the appropriate specific energy value.

9. A turning operation is to be performed on a 20 hp lathe that has an 87% efficiency rating. The roughing cut is made on alloy steel whose hardness is in the range 325 to 335 HB. The cutting speed is 375 ft/min, feed is 0.030 in/rev, and depth of cut is 0.150 in. Based on these values, can the job be performed on the 20 hp lathe? Use Table 21.2 to obtain the appropriate unit horsepower value.

10. In a turning operation on low carbon steel (175 BHN), cutting speed = 400 ft/min, feed = 0.010 in/rev, and depth of cut = 0.075 in. The lathe has a mechanical efficiency = 0.85. Based on the unit values in Table 21.2, determine (a) the horsepower consumed by the turning operation and (b) the horsepower that must be generated by the lathe.

11. A cylindrical workpart 200 mm in diameter and 700 mm long is to be turned in an engine lathe. Cutting speed = 2.30 m/s, feed = 0.32 mm/rev, and depth of cut = 1.80 mm. Determine (a) cutting time, and (b) metal removal rate.

12. In a production turning operation, the foreman has decreed that a single pass must be completed on the cylindrical workpiece in 5.0 min. The piece is 400 mm long and 150 mm in diameter. Using a feed = 0.30 mm/rev and a depth of cut = 4.0 mm, what cutting speed must be used to meet this machining time requirement?

13. A cylindrical work bar with 4.5 in diameter and 52 in length is chucked in an engine lathe and
    supported at the opposite end using a live center. A 46.0 in portion of the length is to be turned to a diameter of 4.25 in one pass at a speed of 450 ft/min. The metal removal rate should be 6.75 in3/min. Determine (a) the required depth of cut, (b) the required feed, and (c) the cutting time.

14. The end of a large tubular workpart is to be faced on a NC vertical boring mill. The part has an outside diameter of 38.0 in and an inside diameter of 24.0 in. If the facing operation is performed at a rotational speed of 40.0 rev/min, feed of 0.015 in/rev, and depth of cut of 0.180 in, determine (a) cutting time to complete the facing operation and the cutting speeds and metal removal rates at
    the beginning and end of the cut.

15. A drilling operation is to be performed with a 12.7 mm diameter twist drill in a steel work part. The hole is a blind hole at a depth of 60 mm and the point angle is 118°. The cutting speed is 25 m/min and the feed is 0.30 mm/rev. Determine (a) the cutting time to complete the drilling operation, and (b) metal removal rate during the operation, after the drill bit reaches full diameter.

16. A two-spindle drill simultaneously drills a ½ in hole and a ¾ in hole through a work piece that is 1.0 inch thick. Both drills are twist drills with point angles of 118°. Cutting speed for the material is 230 ft/min. The rotational speed of each spindle can be set individually. The feed rate for both holes must be set to the same value because the 2 spindles lower at the same rate. The feed rate is set so the total metal removal rate does not exceed 1.50 in3/min. Determine (a) the maximum feed rate (in/min) that can be used, (b) the individual feeds (in/rev) that result for each hole, and (c) the time required to drill the holes.