Kafrelsheikh University
Department of Mech. Eng.
Theory & Tech of Machining MDP3216
Third Year (Production & Mech. Design)

May 2019

Faculty of Engineering
Final Exam (9-6-2019)
Time: 3 hr
Full Mark 75

This Exam measure the following Ilos, a.8, a.13, b.2, b.18, c.5, and d.3

**Answer the following with net sketch**

## Question no. One (10 Mark)

**Choice the correct answer**

1-A roughing operation generally involves which one of the following combinations of cutting conditions? (a) high v, f, and d; (b) high v, low f and d; (c) low v, high f and d; or (d) low v, f, and d.

2- Which of the three types of chip would be expected in a turning operation conducted at low cutting speeds on a brittle work material (one answer)? (a) continuous, (b) continuous with built-up edge, or (c) discontinuous.

3- Which of the following metals would usually have the lowest unit horsepower (one answer)? (a) aluminum, (b) brass, (c) cast iron, or (d) steel.

4- If the cutting conditions in a turning operation are v = 300 ft/min, f = 0.010 in/rev, and d = 0.100 inch, which one of the following is the material removal rate? (a) 0.3 $in^3$/min, (b) 0.025 $in^3$/min, (c)3.0 $in^3$/min, or (d) 3.6 $in^3$/min.

5-According to the Merchant equation, an increase in rake angle would have which of the following results, all other factors remaining the same (more than one)? (a) decrease in friction angle, (b) decrease in power requirements, (c) decrease in shear plane angle, (d) increase in cutting temperature, or (e) increase in shear plane angle.

6-In a turning operation, the change in diameter of the workpart is equal to which one of the following? (a) 1 x depth of cut, (b) 2 x depth of cut, (c) 1 x feed, or (d) 2 x feed.

7-Which of the following are the two main functions of a cutting fluid in machining (two answers only)? (a) improve surface finish on the workpiece, (b) reduce forces and power, (c) reduce friction at the tool-chip interface, (d) remove heat from the process, and (e) wash away chips.

8- Which of the following materials has the highest hardness? (a) aluminum oxide, (b) cubic boron nitride, (c) high speed steel, (d) titanium carbide, or (e) tungsten carbide.

9- Of the following cutting conditions, which one has the greatest effect on tool wear? (a) cutting speed, (b) depth of cut, (c)type of machine or (d) feed.

10- A planing operation is best described by which one of the following: (a) a single point tool moves linearly past a stationary workpart, (b) a tool with multiple teeth moves linearly past a stationary workpart, (c) a workpart is fed linearly past a rotating cutting tool, or (d) a workpart moves linearly past a single-point tool.

## Question no. Two (20 Mark)

**a-** How can the forces acting in metal cutting? Draw force diagram showing geometric relationships between these forces.

**b-** Difference, with net drawing, between basic types of chip.

**c-** A tapered surface is to be turned on an automatic lathe. The workpiece is 750 mm long with minimum and maximum diameters of 100 mm and 200 mm at opposite ends. The automatic controls on the lathe permit the surface speed to be maintained at a constant value of 200 m/min by adjusting the rotational speed as a function of workpiece diameter. Feed = 0.25 mm/rev and depth of cut = 3.0 mm. The rough geometry of the piece has already been formed, and this operation will be the final cut. Determine (a) the time required to turn the taper and (b) the rotational speeds at the beginning and end of the cut.

## Question no. Three (15 Mark)

**a-** Describe the characteristics of , a. High Speed Steel (HSS) tools, b. Cobalt alloys, c. Carbide tools d. Ceramic tools, e. Cubic Boron Nitride (cBN)

**b-** What are the operations related to turning? And what are the common methods used to hold workparts in turning.

**c-** In a turning operation on plain carbon steel whose Brinell hardness = 275 HB, the cutting speed is set at 200 m/min and depth of cut = 6.0 mm. The lathe motor is rated at 25 kW, and its mechanical efficiency = 90%. Using the appropriate specific energy value u = 2.8 N-m/mm$^3$, correction factor =0.9, determine the maximum feed that can be set for this operation

## Question no. Four (15 Mark)

**a-** The part shown in Figure 1 is a power-transmitting shaft; it is to be produced on a lathe from original diameter 0.65 in. List the operations that are appropriate to make this part and estimate the machining time.

**b-** What are the types of milling operations? Discuss the mechanisms that cause wear at the tool–chip and tool–work interfaces in machining

**c-** Turning is performed on a work material with shear strength of 250 MPa. The following conditions are used: $v = 3.0$ m/s, $f = 0.20$ mm/rev, $d = 3.0$ mm, and rake angle = 7° in the direction of chip flow. The resulting chip ratio = 0.5. Using the orthogonal model as an approximation of turning, determine: (a) the shear plane angle; (b) the shear force; (c) cutting force and feed force.

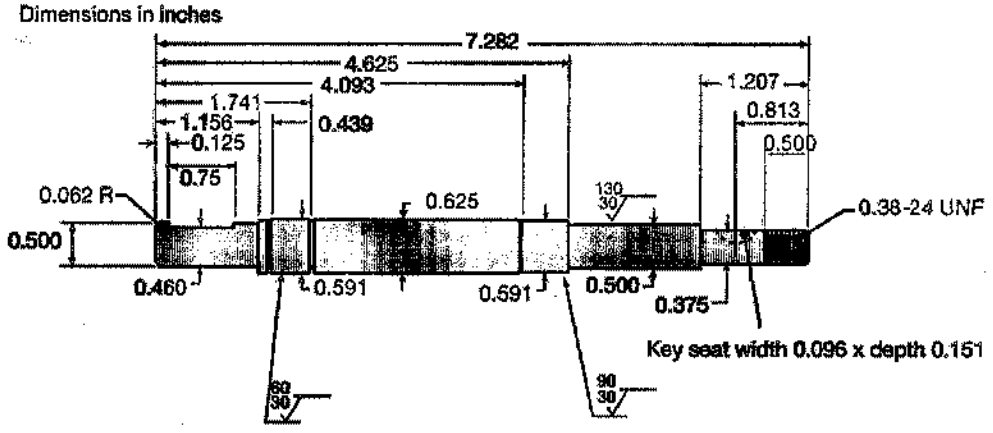


Fig 1

## Question no. Five (15 Mark)

**a-** What are the tool life criteria that are more convenient to use in a production machining operation? Discuss the effect of temperature in metal cutting

**b-** A HSS tool is used to turn a steel workpart that is 300 mm long and 80 mm in diameter. The parameters in the Taylor equation are: $n = 0.13$ and $C = 75$ (m/min) for a feed of 0.4 mm/rev. The operator and machine tool rate = $30.00/hr, and the tooling cost per cutting edge = $4.00. It takes 2.0 min to load and unload the workpart and 3.50 min to change tools. Determine: (a) cutting speed for maximum production rate, (b) tool life in min of cutting, and (c) cycle time and cost per unit of product.

**c-** Tool life tests in turning yield the following data: (1) $v = 100$ m/min, $T = 10$ min; (2) $v = 75$ m/min, $T = 30$ min. (a) Determine the $n$ and $C$ values in the Taylor tool life equation. Based on your equation, compute (b) the tool life for a speed of 90 m/min, and (c) the speed corresponding to a tool life of 20 min.

***Good Luck***

***Prof. Dr. Montasser Dewidar***