IE-352
Section 1, CRN: 13536
Section 2, CRN: 30521
First Semester 1432-33 H (Fall-2011) – 4(4,1,1)
MANUFACTURING PROCESSES - 2

Sunday, Dec 18, 2011 (23/01/1433H)

MIDTERM 2 [10 POINTS]

Name:	Student Number: 4	Section: 8:00 / 10:00

Place the correct letter in the box at the right of each question [$\frac{1}{2}$ Point Each]

Questions 1-4. In an orthogonal cutting operation, a cast-cobalt alloy tool ($where\ V_{T=1\,min} = 220\frac{m}{min}$) was first used in machining a workpiece using the following parameters: $V = 150\ \frac{m}{min}$, $t_o = 0.15\ mm$, $\alpha = 12°$ and the $width\ of\ cut\ =\ 5\ mm$. This resulted in a tool life of $40\ min$, $t_c = 0.20\ mm$, $F_c = 600\ N$ and $F_t = 350\ N$. The process was then repeated under similar conditions at half the cutting speed.

1. **What is the percent change in *tool life* between the two operations?** ☐
   a. a 793-fold increase (i.e. 79,300 %)
   b. a 792-fold increase (i.e. 79,200 %)
   c. a 6.9-fold increase (i.e. 690 %)
   d. a 397-fold increase (i.e. 39,700 %)
   e. a 396-fold increase (i.e. 39,600 %)

2. **What is the percent change in *material cut* between the two operations?** ☐
   a. a 793-fold increase (i.e. 79,300 %)
   b. a 792-fold increase (i.e. 79,200 %)
   c. a 6.9-fold increase (i.e. 690 %)
   d. a 397-fold increase (i.e. 39,700 %)
   e. a 396-fold increase (i.e. 39,600 %)

3. **What is the value of the *friction angle* for the first process?**
   a. 12.0°
   b. 30.3°
   c. 42.3°
   d. 18.3°
   e. 47.7°
4. **What is the percentage of the total energy that goes into overcoming *friction* at the tool–chip interface in the first process?**
   a. 22.1 %
   b. 77.9 %
   c. 45.4 %
   d. 58.4 %
   e. 54.6 %
5. **The process involving a rotating cutter that produces a cavity is called …**
   a. end milling
   b. slab milling
   c. cutting off
   d. straight turning
   e. skiving
6. **The process involving a cutting tool that moves radially inward is called…**
   a. end milling
   b. slab milling
   c. cutting off
   d. straight turning
   e. skiving
7. **The angle formed between the flank face and the workpiece is called the…**
   a. inclination angle
   b. friction angle
   c. shear angle
   d. rake angle
   e. relief angle

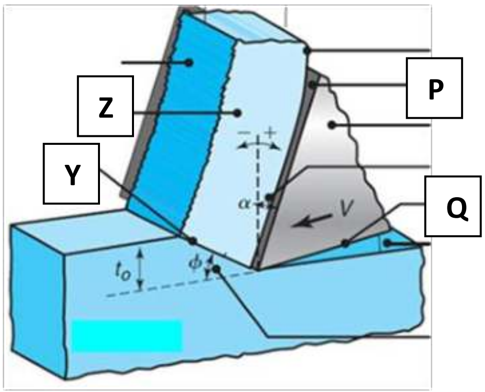
8. **Which of the following is a *dependent* variable in the cutting process?**
   a. cutting speed
   b. tool material
   c. tool surface finish
   d. energy dissipated during cutting
   e. cutting fluids

9. **What type of chips can develop a *secondary* shear zone?**
   a. built-up edge chips
   b. continuous chips
   c. serrated chips
   d. discontinuous chips
   e. chip curls

10. **The *thrust* force experienced in cutting...**
   a. may push the tool away from the workpiece if too high
   b. acts at the shear zone to remove layers of material from the workpiece
   c. is also known as the specific cutting force
   d. supplies the energy required for cutting
   e. acts along the tool-chip interface

11. **Removing a large amount of material at high speeds is termed...**
   a. shaving
   b. skiving
   c. finish machining
   d. rough machining
   e. end milling

12. **Label the diagram shown on the right.**
   a. P: rake face; Q: flank face; Y: shear zone; Z: workpiece
   b. P: flank face; Q: rake face; Y: shear plane; Z: chip
   c. P: rake face; Q: flank face; Y: shear zone; Z: chip
   d. P: flank face; Q: rake face; Y: shear zone; Z: chip
   e. P: rake face; Q: flank face; Y: shear plane; Z: chip



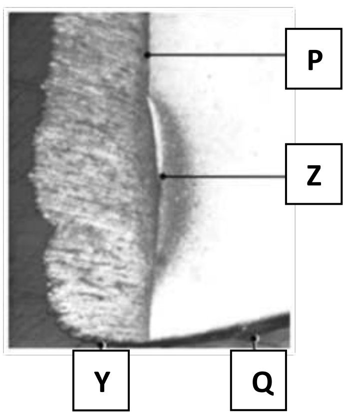
13. **Which of the following scenarios usually involves *more* power consumption?**
   a. using a negative rake angle as opposed to a positive rake angle
   b. low friction at the tool-chip interface friction as opposed to high friction
   c. using sharp tools as opposed to dull tools
   d. machining magnesium alloys as opposed to stainless steels
   e. machining aluminum alloys as opposed to titanium alloys

14. **Where does the maximum *increase* in temperature occur during cutting?**
   a. about half-way up the tool-chip interface
   b. at the tool-tip
   c. at the middle of the shear zone
   d. about half-way up the flank face
   e. at the location where the chip leaves the rake face

15. **Which of the following can measure temperature generated in the cutting zone?**
   a. dynamometer
   b. calculating specific energies for shear and friction
   c. load cell
   d. radiation pyrometer
   e. transducers that measure acoustic emissions

16. **Which of the following can be used to monitor cutting tool condition?**
   a. dynamometer
   b. calculating specific energies for shear and friction
   c. load cell
   d. radiation pyrometer
   e. transducers that measure acoustic emissions

17. **Label the diagram shown on the right.**
   a. P: flank face; Q: rake face; Y: chip; Z: flank wear
   b. P: rake face; Q: flank face; Y: chip; Z: nose wear
   c. P: rake face; Q: flank face; Y: chip; Z: crater wear
   d. P: flank face; Q: rake face; Y: chip; Z: crater wear
   e. P: rake face; Q: flank face; Y: chip; Z: flank wear



18. **Which of the following has the greatest effect on surface *finish*?**
    a. feed marks
    b. high temperatures generated during cutting
    c. tool vibration and chatter
    d. the built-up edge
    e. dull tools

19. **Which of the following has the largest effect on surface *integrity*?**
    a. feed marks
    b. high temperatures generated during cutting
    c. tool vibration and chatter
    d. the built-up edge
    e. dull tools

20. **Which of the following is a safe, non-ferrous metal, with high machinability?**
    a. Tungsten
    b. Cold-worked carbon steel
    c. Aluminum
    d. Leaded steels
    e. Magnesium

Equations, Diagrams You May Find Useful

$$\tan\phi = \frac{r\cos\alpha}{1 - r\sin\alpha} \Rightarrow r = \frac{t_0}{t_c} = \frac{\sin\phi}{\cos(\phi-\alpha)}$$

$$\alpha_e = \sin^{-1}\left(\sin^2 i + \cos^2 i \sin\alpha_n\right)$$

$$T = \frac{0.000665 Y_f}{\rho c}\sqrt[3]{\frac{V t_0}{K}}$$

$$r = \frac{t_0}{t_c} = \frac{V_c}{V}$$

$$T_{mean} \propto V^a f^b$$

$$\gamma = \frac{AB}{OC} = \frac{AO}{OC} + \frac{OB}{OC} \Rightarrow \gamma = \cot\phi + \tan(\phi - \alpha)$$

$$VT^n = C$$

$$\frac{V}{\cos(\phi-\alpha)} = \frac{V_s}{\cos\alpha} = \frac{V_c}{\sin\phi}$$

$$VT^n d^x f^y = C$$

$$\phi = 45° + \frac{\alpha}{2} - \frac{\beta}{2}$$

$$\Rightarrow \phi = 45° + \alpha - \beta \text{ (when } \mu = 0.5 \sim 2)$$

$$T = C^{1/n} V^{-1/n} d^{-x/n} f^{-y/n}$$

$$T \approx C^7 V^{-7} d^{-1} f^{-4}$$

$$Power = F_c V$$

$$\text{Power for friction} = F V_c$$

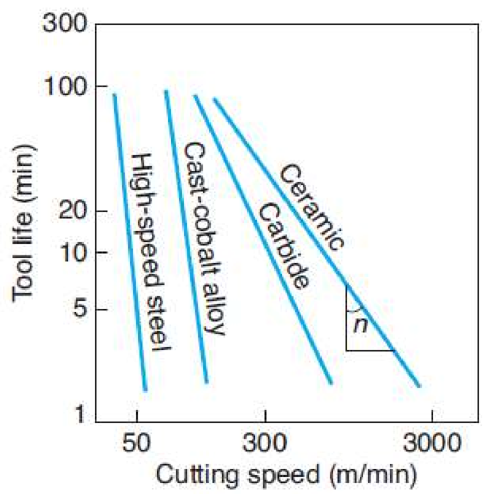
$$\text{Power for shearing} = F_s V_s$$

$$R_t = \frac{f^2}{8R}$$

$$r = \frac{t_0}{t_c} = \frac{V_c}{V}$$

$$u_t = u_s + u_f \qquad u_s = \frac{F_s V_s}{w t_0 V}$$

$$u_f = \frac{F V_c}{w t_0 V} = \frac{Fr}{w t_0}$$



$$\mu = \frac{F}{N} = \frac{F_t + F_c\tan\alpha}{F_c - F_t\tan\alpha}$$

$$F_s = F_c\cos\phi - F_t\sin\phi$$

$$F_n = F_c\sin\phi + F_t\cos\phi$$

$$F_t = R\sin(\beta - \alpha) \text{ or } F_t = F_c\tan(\beta - \alpha)$$