IE-352
Section 1, CRN: 48703/4/5
Section 2, CRN: 48706/7/8
First Semester 1436-37 H (Fall-2015) – 4(4,1,2)
"MANUFACTURING PROCESSES – 2"

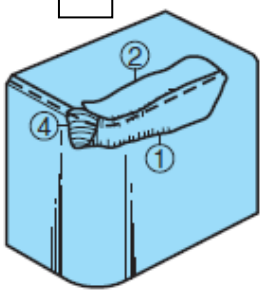
Thursday, November 26, 2015 (14/02/1437H)

HW 2 (MIDTERM 2)

Name:	Student Number: 4	Section: Darwish / Sherb.

Place the correct letter in the box at the right of each question [0.5 Pt. Each]

1. **Label the … cutting tool diagram shown below.** ☐



A. HSS; ①: wear land; ②: crater wear; ④ : oxidation wear

B. carbide; ①: DOC line; ②: failure face; ④: outer-metal chip notch

C. HSS; ①: DOC line; ②: failure face; ④: outer-metal chip notch

D. ceramic; ①: wear land; ②: crater wear; ④: failure face

E. ceramic; ①: wear land; ②: crater wear; ④: oxidation wear

2. **An increase in shear strain is associated with …** ☐

A. decrease in shear angle; decrease in rake angle; decrease in friction angle

B. decrease in shear angle; decrease in rake angle; increase in friction angle

C. decrease in shear angle; increase in rake angle; increase in friction angle

D. increase in shear angle; decrease in rake angle; decrease in friction angle

E. increase in shear angle; increase in rake angle; increase in friction angle

3. **… chips have a … area of low γ and a … area of high γ .** ☐

A. segmented; large; small

B. discontinuous; large; small

C. segmented; small; large

D. discontinuous; small; large

E. BUE; large; small

4. **Which of the following should have the highest hardness?…**

A. workpiece

B. BUE chip

C. tool

D. continuous chip

E. segmented chip

5. **The units of which of the following two properties are the same?**

A. u_t and V

B. u_t and mechanical efficiency

C. u_t and r

D. u_t and specific cutting force

E. u_t and material removal rate

6. **The product of (*cut material width * depth of cut * cutting speed*) is known as…**

A. power

B. specific force

C. specific energy

D. total energy

E. material removal rate

7. **Equation for mean temperature in turning on a lathe shows that …**

A. HSS tools heat up more than carbide tools; V has a greater effect on temp. than f

B. HSS tools heat up more than carbide tools; f has a greater effect on temp. than V

C. carbide tools heat up more than HSS tools; f has a greater effect on temp. than V

D. carbide tools heat up more than HSS tools; V has a greater effect on temp. than f

E. HSS tools heat up more than carbide tools; f and V have the same effect on temp.

8. **According to the Taylor Equation, tool life in turning decreases most with …**

A. increase in feed

B. increase in rake angle

C. increase in friction

D. increase in cutting speed

E. increase in cutting depth

9. **Feed marks generated due to turning become *less visible* as a result of …**

A. higher feed; duller tool

B. lower feed; duller tool

C. higher feed; sharper tool

D. lower feed; sharper tool

E. higher feed; higher speed

10. **Vibration causes ... while chatter causes …**

A. chipping and premature failure in diamond tools; changes in cutting dimensions

B. changes in cutting dimensions; chipping and premature failure in HSS tools

C. changes in cutting dimensions; chipping and premature failure in carbide tools

D. changes in cutting dimensions; chipping and premature failure in diamond tools

E. chipping and premature failure in HSS tools; changes in cutting dimensions

11. **Removing a large amount of material at high speeds is termed...**

A. shaving

B. finish machining

C. rough machining

D. skiving

E. end milling

12. ***S* and *P* are added to increase the machinability of which steel type?**

A. free-machining steels

B. stainless steels

C. carbon steels

D. alloy steels

E. calcium-deoxidized steels

13. **Which of the following workpiece materials have a tendency to form a BUE?**

A. gray irons and aluminum

B. martensitic steels and copper

C. ferritic steels and cobalt-based alloys

D. leaded steels and beryllium

E. magnesium and zirconium

14. **Which workpiece materials listed below pose an environmental toxicity hazard?** ☐

A. gray irons and tungsten

B. ferritic steels and cobalt-based alloys

C. martensitic steels and copper

D. magnesium and zirconium

E. leaded steels and beryllium

Questions 15-20. In an orthogonal cutting operation using a HSS tool ($n = 0.1$), $t_o = 0.17\ mm$, $\alpha = 24°$ and the $w = 6\ mm$. It is observed that $t_c = 0.27\ mm$, $F_c = 350\ N$ and $F_t = 200\ N$.

15. **What is the value of the *chip-thickness ratio*?** ☐

A. 1.59

B. 0.05

C. 0.27

D. 0.63

E. 0.17

16. **What is the value of the *shear angle*?** ☐

A. 31.1°

B. 37.7°

C. 58.9°

D. 45.0°

E. 52.3°

17. **What is the value of the *resultant force*?** ☐

A. 550 N

B. 265 N

C. 403 N

D. 350 N

E. 200 N

18. **What is the value of the *friction angle and coefficient of friction?***

A. $36.3°$; 0.74

B. $29.7°$; 0.57

C. $53.7°$; 0.57

D. $29.7°$; 1.36

E. $53.7°$; 1.36

19. **Find the percentage of total power that goes into overcoming friction?**

A. 58.5%

B. 41.5%

C. 92.9%

D. 67.8%

E. 32.2%

20. **What is the effect on *tool life* of increasing the cutting speed by 50%?**

A. reduction in tool life by 1.7%

B. reduction in tool life by 57.7%

C. reduction in tool life by 98.3%

D. reduction in tool life by 42.3%

E. reduction in tool life by 66.7%

Rules:

- You must prepare and submit the homework **individually**.
- Your work must be **neatly written** in pencil (or typed) and in **proper English** (where applicable).
- **You must show all work**.
- **BOX** your answer(s) and include the **units**.

Due date:

- **Sunday, December 06, 2015** (24/02/1437)

Equations, Data, Diagrams You May Find Useful

$$\log x^p = p\log x, \quad \log xy = \log x + \log y, \quad \log\frac{x}{y} = \log x - \log y$$

$$\tan\phi = \frac{r\cos\alpha}{1 - r\sin\alpha} \Rightarrow r = \frac{t_0}{t_c} = \frac{\sin\phi}{\cos(\phi - \alpha)} \qquad \alpha_e = \sin^{-1}\left(\sin^2 i + \cos^2 i \sin\alpha_n\right)$$

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

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

$$\textit{Shear Stress} = \frac{F_s}{\textit{Area of the shear plane}}$$

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

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

$$\Rightarrow \phi = 45° + \alpha - \beta$$

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

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

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

$$T = \frac{0.000665 Y_f}{\rho c}\sqrt[3]{\frac{Vt_0}{K}}$$

$$\textit{Power} = F_c V$$

$$\text{Power for friction} = FV_c$$

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

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

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

- *Carbide tools*: $a = 0.2$, $b = 0.125$
- *High-speed steel tools*: $a = 0.5$, $b = 0.375$

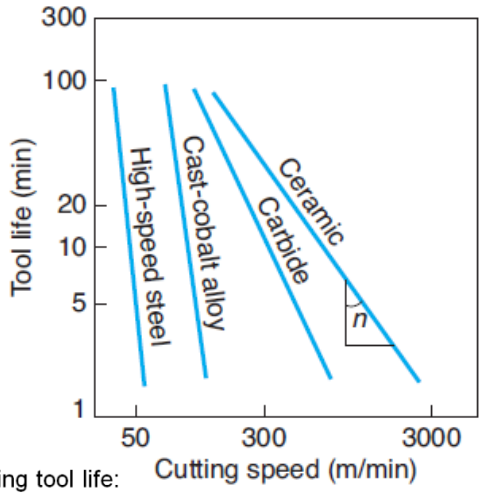
$$u_t = u_s + u_f \qquad u_s = \frac{F_s V_s}{wt_0 V}$$

$$u_f = \frac{FV_c}{wt_0 V} = \frac{Fr}{wt_0}$$

$$\eta_{mech} = \frac{Power_c}{Power_{source}}$$

Ranges of *n* Values for the Taylor Equation (21.20a) for Various Tool Materials

High-speed steels	0.08–0.2
Cast alloys	0.1–0.15
Carbides	0.2–0.5
Coated carbides	0.4–0.6
Ceramics	0.5–0.7



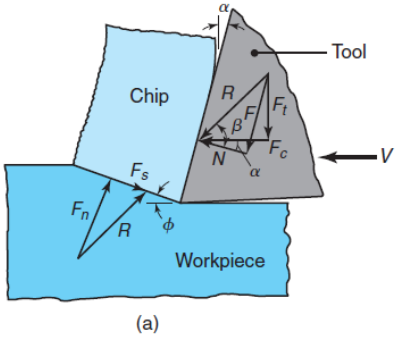
$$\mu = \tan\beta = \frac{F}{N} = \frac{F_t + F_c\tan\alpha}{F_c - F_t\tan\alpha}$$

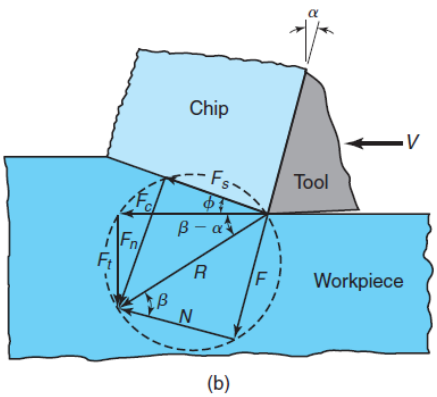
$$F_s = F_c\cos\phi - F_t\sin\phi$$

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

- Recommended cutting speed is one producing tool life:
  - 60-120 min: high-speed steel tools
  - 30-60 min: carbide tools

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





Approximate Range of Energy Requirements in Cutting Operations at the Drive Motor of the Machine Tool (for Dull Tools, Multiply by 1.25)

Material	Specific energy W · s/mm³
Aluminum alloys	0.4–1
Cast irons	1.1–5.4
Copper alloys	1.4–3.2
High-temperature alloys	3.2–8
Magnesium alloys	0.3–0.6
Nickel alloys	4.8–6.7
Refractory alloys	3–9
Stainless steels	2–5
Steels	2–9
Titanium alloys	2–5