IE-352
Section 1, CRN: 48700/1/2
Section 2, CRN: 48703/4/5
Section 3, CRN: 48706/7/8
Second Semester 1434-35 H (Spring-2014) – 4(4,1,2)
"MANUFACTURING PROCESSES – 2"

Sunday, April 27, 2014 (27/06/1435H)

HW 3 (MIDTERM 2)

Name:	Student Number: 4	Section: S/M8/M10

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

1. ***Classify*, respectively, the following geometric symbols:** ◎, ⌭, ○: ☐

   A. location, form, location

   B. form, form, form

   C. location, location, location

   D. form, form, location

   E. location, form, form

Questions 2-3. Examine the feature control frame shown below and answer the questions to follow.

⌖	Ø0.1	A	B	C

2. **How do you read the feature control frame shown above?** ☐

   A. position GT of feature is a 0.1-diam. cylind. zone relative to datums A, B, C at Ⓜ

   B. position GT of feature is a 0.1-diam. cylind. zone relative to datums $A, B,\ C$ at Ⓛ

   C. position GT of feature is a 0.1-diam. cylind. zone relative to datums A, B, C at Ⓢ

   D. cylindricity GT of feature is a 0.1-diam. cylind. zone relative to datum A, B, C at Ⓜ

   E. cylindricity GT of feature is a 0.1-diam. cylind. zone relative to datums A, B, C at Ⓢ

3. **The feature control frame above can be used for a hole in which type of fit?**

   A. interference fits

   B. clearance fits

   C. transition fits

   D. clearance or interference fits

   E. any type of fit

4. **The major difference between flatness and parallelism tolerance for a plane is …**

   A. parallelism tolerance must have a material condition modifier

   B. parallelism tolerance must be defined relative to a datum

   C. parallelism tolerance must have a material modifier & be defined relative to a datum

   D flatness tolerance must be defined relative to a datum

   E. flatness tolerance must have a material condition modifier

5. **For the system shown below, $GT_{LMC} =$**

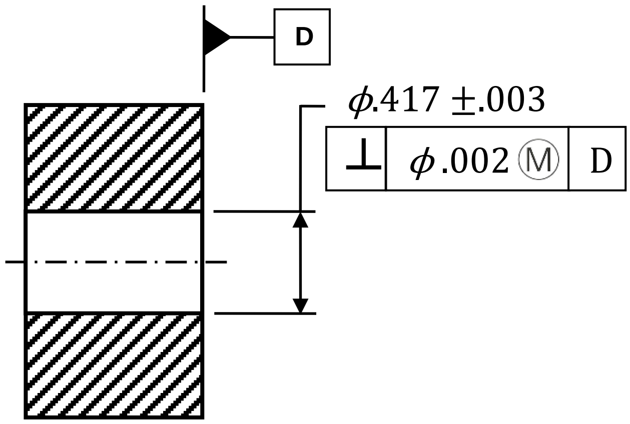
   A. 0.002

   B. 0.003

   C. 0.005

   D. 0.006

   E. 0.008



6. **Repeat P5 above given *no* material condition modifier is defined in the FCF.**

   A. 0.002

   B. 0.003

   C. 0.005

   D. 0.006

   E. 0.008

7. **Which of the following machining parameters is *always* smaller than unity (<1)?**

   A. r and γ

   B. μ and γ

   C. r and η_{mech}

   D. u_t and η_{mech}

   E. μ and u_t

8. **Which of the following machining parameters is not "unitless" (i.e. has units)?**

   A. r

   B. u_t

   C. γ

   D. μ

   E. η_{mech}

9. **Label the cutting tool diagram shown below**

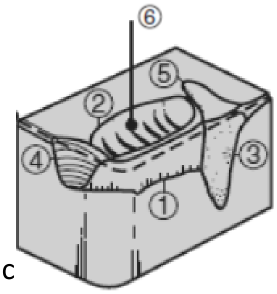
   A. ①: flank wear; ②: crater wear; ③: depth-of-cut line; ⑥: thermal cracks

   B. ①: crater wear; ②: flank wear; ③: depth-of-cut line; ⑥: thermal cracks

   C. ①: flank wear; ②: crater wear; ③: thermal cracks; ⑥: depth-of-cut line

   D. ①: flank wear; ②: thermal cracks; ③:depth-of-cut line; ⑥:crater wear

   E. ①: flank wear; ②: crater wear; ③: outer metal chip notch; ⑥: thermal crac



10. **The *Taylor Tool Life* equation measures time to develop which type of wear?**

    A. KT

    B. R

    C. VN

    D. VB

    E. VB_{max}

11. **Allowable notch wear is given by the symbol: …**

   A. KT

   B. R

   C. VN

   D. VB

   E. VB_{max}

12. **Maximum crater wear is given by the following symbol: …**

   A. KT

   B. R

   C. VN

   D. VB

   E. VB_{max}

Questions 13-20. In an orthogonal cutting operation using a coated carbide tool ($n = 0.6$), $t_o = 0.39\ mm$, $V = 35\ m/min$, $\alpha = 18°$ and the $w = 9\ mm$. It is observed that $t_c = 0.85\ mm$, $F_c = 720\ N$ and $F_t = 345\ N$.

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

   A. 2.18

   B. 0.33

   C. 3.02

   D. 0.46

   E. 1.0

14. **What is the value of the *shear angle*?**

   A. 14.1°

   B. 27.0°

   C. 75.9°

   D. 63.0°

   E. 72.0°

15. **What is the value of the *shear strain*?**

A. 1.96

B. 0.67

C. 2.12

D. 1.16

E. 0.16

16. **What is the value of the *chip velocity*?**

A. 76.3 m/min

B. 5.7 m/min

C. 91.7 m/min

D. 16.1 m/min

E. 17.5 m/min

17. **What is the magnitude of the *coefficient of friction*?**

A. 1.05

B. 7.49

C. 0.13

D. 2.63

E. 0.95

18. **How much *energy* is required for 10 minutes of cutting?**

A. 25.2 kJ

B. 252 kJ

C. 43.2 kJ

D. 0.72 kJ

E. 1512 kJ

19. **What is the effect on *tool life* of doubling the cutting speed?**

A. reduction in tool life by 50.0%

B. reduction in tool life by 31.4%

C. reduction in tool life by 66.0%

D. reduction in tool life by 68.5%

E. reduction in tool life by 34.0%

20. **What is the effect on *material removal rate* of doubling the cutting speed?**

A. increase in the MRR by 50%

B. decrease in the MRR by 50%

C. doubling of the MRR

D. increase in the MRR by 200%

E. increase in the MRR by 150%

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).
- **Show all work**, and answer each question on a **separate sheet**.
- **BOX** your answer(s) and include the **units**.

Due date:

- **Sunday, May 04, 2014 (S2)**, 2014 (05/07/1435)
- **Monday, May 04, 2014 (S1,S3)**, 2014 (06/07/1435)

Equations, Data, Diagrams You May Find Useful

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

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

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

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

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

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

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

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

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

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

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

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

$$Power = F_c V$$

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

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

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

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

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

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

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

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

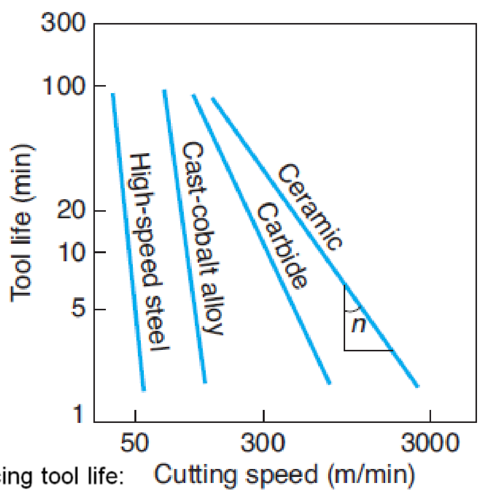
$$\mu = \frac{F}{N} = \frac{F_t + F_c\tan\alpha}{F_c - F_t\tan\alpha}$$

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

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

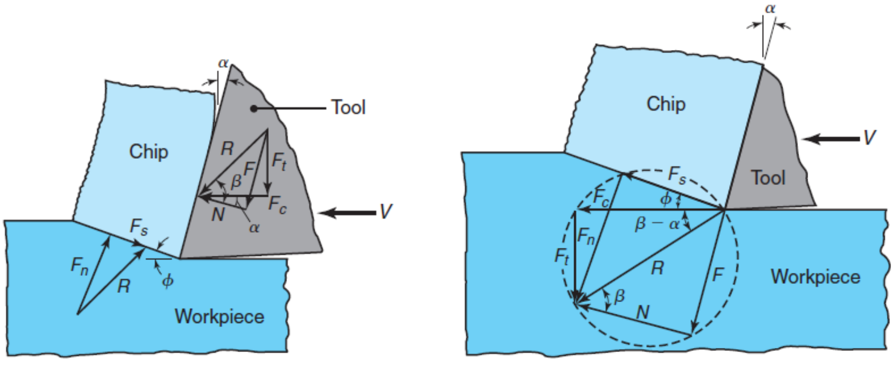
Ranges of *n* Values for the Taylor Equation (21.20a) for Various Tool Materials

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



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

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



(a) (b)

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