AEM 313: Practice Exam 2 Name:________________________

25th Oct 2016 75 minutes 6 Pages Open books, Open notes, Calculator

100 total points **Read, think, plan, and then write.**

Lessons 12 - 18

Anderson book Chap 4-5

University of Alabama Academic Honor Pledge:

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Signature:______________________________

Date:______________________________

Multiple Choice Problems: Circle **EVERY** correct answer [3 pts each]

1. A flat elliptical wing has an aspect ratio of 8. What is C_{L_α}?

A.	B.	C.	D.	E. None of the above

2. A flat elliptical wing has an aspect ratio of 8. What is C_{D_i} at $C_L = 0.5$?

A.	B.	C.	D.	E. None of the above

3. A flat tapered wing has an aspect ratio of 8 and taper ratio of 0.5. What is C_{D_i} at $C_L = 0.5$?

A.	B.	C.	D.	E. None of the above

4. For a subsonic flat linearly tapered wing, which taper ratio gives the lowest induced drag?

1. 0.0	2. 0.3	3. 0.5	4. 1.0	1.5

5. Compute the induced drag described by an upstream velocity of u=1 at SSL and a downstream velocity defined by:

v^2

$$v^2 + w^2 = \begin{cases} 0.1 & r < 1 \\ 0 & otherwise \end{cases}$$

A.	B.	C.	D.	E. None of the above

5. Why is the lift distribution $\Gamma(y) = y$ not physically possible for a finite wing of span b=1?

A. Negative Γ	B. Not elliptical	C. Asymmetrical	D. Infinite velocities	E. None of the above

6. Determine the lift coefficient of a wing of span b=2 given the following bound vortex distribution:

$$\Gamma(y) = \cos\left(\pi \frac{y}{b}\right)$$

A.	B.	C.	D.	E. None of the above

7. Why do increasing lengths of contrails indicate the increasing possibility of stormy weather?

A. Combustion provides ionic paths for lightning	B. Vortices create an unstable atmosphere	C. Contrails increase atmospheric heating	D. Atmospheric moisture is increasing	E. None of the above

8. In the following figure, where is the shed vorticity in the wake highest?

F. Combustion provides ionic paths for lightning	G. Vortices create an unstable atmosphere	H. Contrails increase atmospheric heating	I. Atmospheric moisture is increasing	J. None of the above

9. A finite wing with AR=10 has the following Fourier coefficients. What is the lift coefficient?

$$A_n = 0.1^n$$

A.	B.	C.	D.	E.

10. In a panel method for an airfoil, where are numerical instabilities most likely to occur?

A. Trailing Edge	B. Leading Edge	C. Freestream	D. Maximum thickness	E. None of the above

11. Where is the theoretical aerodynamic center of a flying wing?

A. Neutral point	B. Half chord	C. Quarter Chord	D. Leading edge	E. None of the above

12. For a delta wing, increasing AOA tends to move the vortex burst point

A. Forward	B. Aft	C. Outboard	D. Below the wing	E. Does not move

13. For attached flow over an NACA 0012 airfoil, where is the vorticity concentrated?

A. Everywhere	B. Quarter Chord	C. Wake	D. Near the surface	E. Nowhere. Zero vorticity

14. For a high speed aircraft at high altitudes, where are contrails likely to 1st occur?

A. Wing tips	B. Jet exhausts	C. Strakes	D. Wing root	E. Flap tips

$V = \frac{\Gamma}{4\pi}\frac{1}{h} = \frac{1}{4\pi}$

15. What is the velocity imposed by a semi-infinite vortex of strength 1 at a distance h=1?

A.	B.	C. $\frac{1}{4\pi}$	D.	E.

16. Which wing geometries tend to have higher C_l loading near the wingtips?

A. Aft swept	B. Forward swept	C. Washout	D. Washin	E. Elliptical wings

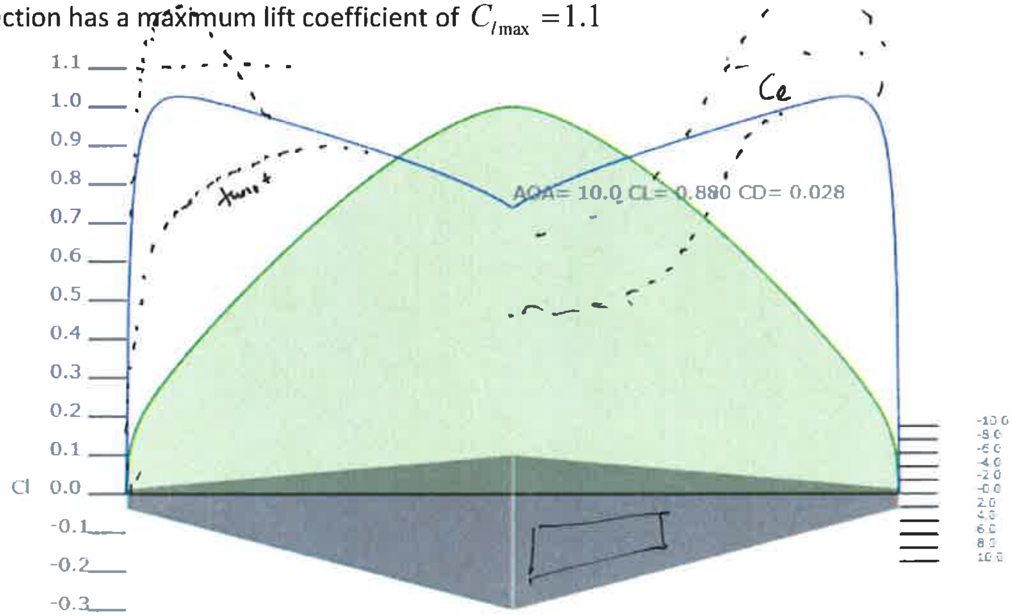
17. Circle the phenomena described: A positive roll moment creates an opposite yaw moment.

A. Induced Drag	B. Adverse Yaw	C. Proverse Yaw	D. Aileron Reversal	E. Not possible

18. Circle the Helmholtz ~~vortex filament theorems~~

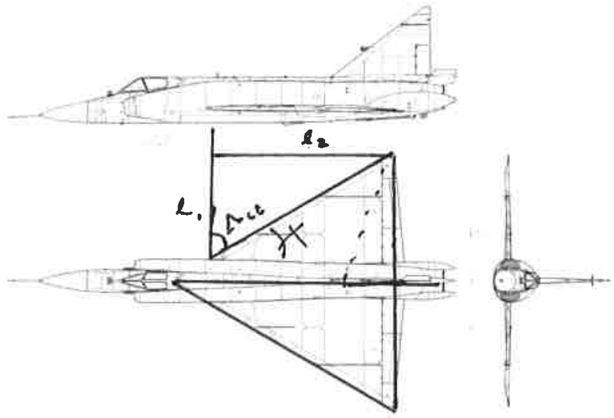
A. Constant filament strength	B. Filaments never end within a fluid	C. Filaments convect downstream	D. Filaments shapes remain constant	E. Filaments decay exponentially

19. Given the following lift distribution at AOA=10 degrees, which wing modifications are likely to improve flight performance and pilot workload during high AOA maneuvers near stall? Assume that the airfoil section has a maximum lift coefficient of $C_{l\max} = 1.1$



A. Washin	B. Washout	C. Aft sweep	D. Decrease the taper ratio	E. Inboard spoilers deflected 10 degrees

20. Estimate the lift to drag ratio (CL/CD) of an F-102 Delta Dagger at AOA=35 degrees?



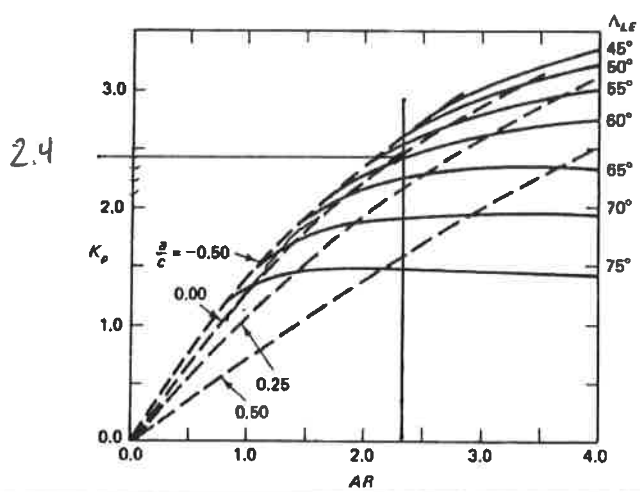
$\tan \Lambda = \frac{24}{14} = 60°$

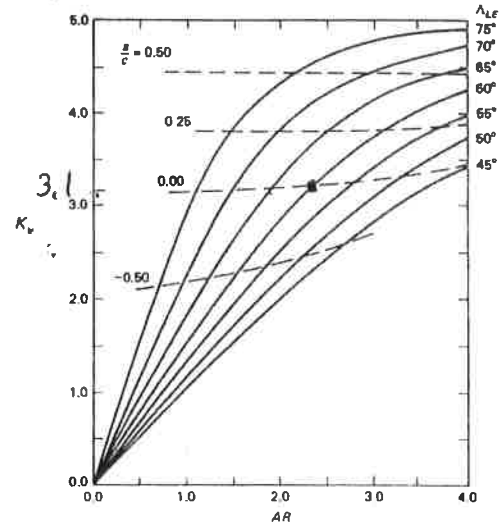
$\bar{c} = \frac{30}{2} = 15$

$b = 34$

$S = 510$

$AR \approx 2.3$





A.	B.	C.	D.	E.

$K_p = 2.4$ $K_v = 3.1$

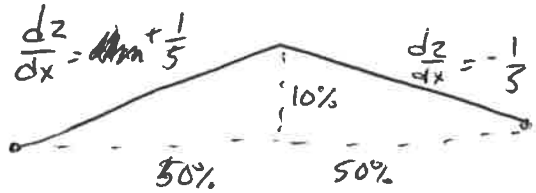
$\sin 35° = 0.5735$

$\cos 35° = 0.8192$

$$\frac{C_L = K_p \sin\alpha \cos^2\alpha + K_v \cos\alpha \sin^2\alpha}{C_D = K_p \sin^2\alpha \cos\alpha + K_v \sin^3\alpha} = \frac{1.759}{1.231}$$

$= 1.43$

21. [20 pts] Estimate the lift, drag, and moment of a thin cambered airfoil at AOA=0. The airfoil is composed of two linear parts. The maximum camber is 10% at the midchord.



$$A_0 = \alpha - \frac{1}{\pi}\int_0^{\pi/2} \frac{1}{5}\, d\theta - \frac{1}{\pi}\int_{\pi/2}^{\pi} -\frac{1}{5}\, d\theta$$

$$= \alpha - \frac{1}{\pi}\frac{1}{5}\frac{\pi}{2} + \frac{1}{\pi}\frac{1}{5}\left(\pi - \frac{\pi}{2}\right)$$

$$= \alpha - \frac{1}{10} + \frac{1}{10} \rightarrow 0$$

$$A_1 = \frac{2}{\pi}\int_0^{\pi/2} \frac{1}{5}\cos\theta\, d\theta + \frac{2}{\pi}\int_{\pi/2}^{\pi} -\frac{1}{5}\cos\theta\, d\theta = \frac{2}{\pi}\frac{1}{5}\cdot 2 = \frac{4}{5\pi}$$

$$A_2 = \frac{2}{\pi}\int_0^{\pi/2} \frac{1}{5}\cos 2\theta\, d\theta + \frac{2}{\pi}\int_{\pi/2}^{\pi} -\frac{1}{5}\cos 2\theta\, d\theta = 0$$

$$C_l = 2\pi A_0 + \pi A_1 = 2\pi(\alpha) + \frac{4}{5}$$

$$= \frac{4}{5} = \boxed{0.8}$$

$$\boxed{C_d = 0}$$

$$C_m = -\frac{\pi}{4}(A_1 - A_2) = -\frac{1}{5} = \boxed{-0.2}$$