Aerodynamics and Aeroeslasticity

Homework 6

Due to March 6 2017

***Problem 1***

The strength of a vortex filament is ᴦ in the shape of a closed circular loop of radius R. Calculate the induced velocity at the center of the loop for a $ᴦ=2π $m2/s and R=5m.

**Problem 2**

NACA 23012 airfoil the slope is 0,1080/degree, and $α\_{L=0}=-1,3°$. Calculate the lift and induced drag coefficients for this wing at a geometric angle of attack $α=7°$Considering a finite wing using this airfoil, with AR=8 and taper ratio 0,8. Assume $ δ=τ$ , where $δ=0.054$.

***Problem 3***

The piper Cherokee has a wing area of 170ft2 and a wing span of 32ft. Its maximun gross weight is 2450lb. The wing uses an NACA 65-415 airfoil which has a lift slope of 0,1033/degree. And $α\_{L=0}=-3°$. Asuume $τ=0.12$. If the airplane is crusing at 120mi/h at standard sea level at its maximun gross weight and is in straight and level flight. Calculate the geometric angle of attack of the wing.

***Problem 4***

Consider the airplane and flight conditions given in problem 3: The Span efficiency factor for the complete airplane is generally much less than that for the finite wing alone. Assume e=0,64. Calculte the induced drag for the airplane of the problem 3.

**Problem 5**

Design an untwisted elliptical wing fying at 300km/hr in sea-level conditions air. The angle of attack α must less than 12° to avoid stall. For the wing of minimum induced drag, specify its aspect ratio, wing span, maximum chord and the power required to compasate induced drag. Consider the following specifications, lift 45000N, planform 30m2 and wing span must be less than 12m

***Problem 6***

Consider an untwisted rectangular wing with chord of 1.2m and span of 6m flying with angle of attact of $α=4°$.The airfoil is thin and symmetric along the wingspan and Cdo=0,002. Determine the lift and induced drag coefficient. The airplane cruise speed is 200m/s and flying at altitude where the density is 0,98kg/m3.Determine the power needed to overcome the induced drag, the total drag, induced velocity and angle. Determine the total drag if the aspect ratio is 9.

**Problem 7**

Show that for a symmetrically loaded wing , An, in$ ᴦ\left(θ\right)=2bV\_{\infty }\sum\_{1}^{N}A\_{n}sin(nθ)$vanish for even values of n.