**MAE224 Fluids Lab #4 Hydrostatics**

**Instructions:** Complete this worksheet as you work through the lab. Once completed, submit it on Gradescope before the start of your lab the week of April 4.

**Exercise 1 (Group):** Airfoil Simulation (Qblade) **Group**

**A)** Plot the pressure coefficient vs x for the NACA0018 airfoil at one Reynolds number

**B)** Plot the lift coefficient as a function of angle of attack for the NACA0018 at one Re number

**C)** Plot the drag coefficient as a function of angle of attack for the NACA0018 at one Re number

**D)** Change the Re number of your simulations. What happens to the lift and drag curves?

**E)** The “Stall Point” is known as the location where the lift curve drops off. How does Re affect this point?

**F)** Make some new airfoils with varying thicknesses and cambers either by using the NACA profile generator or downloading and importing them from airfoiltools.com. Answer these questions:

i. Generally, what is the effect of camber on an airfoil in terms of the stall point and maximum lift generated?

ii. How does the thickness of an airfoil affect its lift and drag?

**Exercise 2 (Group):** Airfoil Experiment (Wind Tunnel)

**A)** Plot the pressure coefficient vs x for the NACA0018 airfoil obtained experimentally with that found using Qblade in Exercise 1A on the same figure. How do they compare? *(5 pts)*

**B)** Plot the lift coefficient as a function of angle of attack for the NACA0018 with that found using Qblade in Exercise 1B on the same figure. How do they compare? Be sure to use your pressure distribution to find the lift coefficient (you can compare your calculation to the lift coefficient obtained using the direct force measurement) *(5 pts)*

**C)** Plot the drag coefficient as a function of angle of attack for the NACA0018 obtained experimentally with that found using Qblade in Exercise 1C on the same figure. How do they compare? Be sure to use your pressure distribution to find the drag coefficient (you can compare your calculation to the drag coefficient obtained using the direct force measurement) *(5 pts)*

**D)** Compare how the experimental lift and drag curves change with Reynolds number to the observations in Exercise 1D. Explain possible reasons for any differences observed. *(5 pts)*

**E)** Compare how the experimental stall point changes with Reynolds number to the observations in Exercise 1E. Explain possible reasons for any differences observed. *(5 pts)*

**Exercise 3 (Individual):** Discussion questions

**A)** For both the experiment and simulation, what happens to the lift at zero angle of attack? Why?

**B)** The lift appears to decrease at a certain angle of attack, why do you think this is the case? The drag increases sharply also, why is this? Are these two phenomena related?

**C)** Given the above, why is a plot of the lift and drag coefficients useful?

**D)** Where do you suppose most aircraft operate in terms of angle of attack?

**E)** Stunt planes are capable of flying upside down. How is this possible?