Homework #4 **MEAM 5450 - Fall 2022**

Assigned: 10/25/2022, Due: 11/01/2022

$$Airfoil\ plane \rightarrow z = x + iy$$
$$Circle\ plane \rightarrow\ \zeta = \chi + i\eta, Center\ of\ circle \rightarrow\ \mu_x + i\mu_y$$
$$Circle\ pass\ through\ \chi = 1\ and\ encompases\ \chi = -1, Radius = R$$
$$Freestream\ velocity \rightarrow V_\infty, Angle\ of\ attack \rightarrow\ \alpha$$
$$Transform \rightarrow z = \zeta + \frac{1}{\zeta}$$
$$x = \frac{\chi(\chi^2 + \eta^2 + 1)}{\chi^2 + \eta^2}$$
$$y = \frac{\eta(\chi^2 + \eta^2 - 1)}{\chi^2 + \eta^2}$$
$$Velocity\ in\ Circle\ plane \rightarrow \widetilde{W} = \tilde{u} - i\tilde{v} = V_\infty e^{-i\alpha} + \frac{i\Gamma}{2\pi(\zeta - \mu)} - \frac{V_\infty R^2 e^{i\alpha}}{(\zeta - \mu)^2}$$
$$\text{Circulation to satisfy kutta condition} \rightarrow \Gamma = 4\pi V_\infty R sin\left(\alpha + sin^{-1}\frac{\mu_y}{R}\right)$$
$$Velocity\ in\ airfoil\ plane \rightarrow W = \frac{\widetilde{W}}{1 - \frac{1}{\zeta^2}} = u - iv$$

Use the Joukowsky Transform (pertinent equations above) to analyze a 12% thickness airfoil:

1.) Show the pressure distribution at 0, 5, 10, 15 degree angles of attack, comment on results
2.) Calculate the coefficient of lift as a function of angle of attack, compare results against NACA 0012 data. How does this compare to cl = 2*pi*alpha?
3.) Add camber (maximum of 2% chord) and repeat 1 and 2