2.23 Hydrofoils & Propellers
Homework Assignment #1

Assigned: Monday February 12, 2007
Due: Friday February 19, 2007

1) Develop a matlab code to read in a propeller geometry.

   a) Write functions to return the camber and thickness at an input value of chordwise position (x) for a parabolic meanline and elliptical thickness distribution given max. camber and max. thickness. Parabolic meanline and elliptical thickness forms are describes as follows:

$$f(x) = f_o[1-(\frac{2x}{c})^2]$$

$$t(x) = t_o\sqrt{[1-(\frac{2x}{c})^2]}$$

   b) Write a code to read in the attached blade input file. Assume the thickness and meanline distribution are elliptical and parabolic respectively.
   c) Then using the parabolic meanline and elliptical thickness orient compute points on the upper and lower surface of the blade at each 3D section properly in the propeller space. Use about 100 points for each side of each section
   d) Generate a 3D plot of the upper surface and lower surface of the entire blade. The plot of both together should look like a propeller blade.

2) A propeller on a ship body has a diameter of 2.1 meters and has an engine capable of producing 8,000 Kw. Using Actuator Disk Theory:

   a) Plot the limiting top speed for this ship as a function of drag on the ship. (assume a lower limit on drag of 200kN)

   b) If the ship moves at 12 knots what is the maximum drag that this hull could have?

   c) At this speed what is the wake diameter exiting the propeller far downstream?

3) You are asked to design a 5 bladed B-Series (Wangenin B5-75) propeller for a ship having the following requirements:

- Ship Speed 10 m/s
- Shaft Speed 120 RPM (2 RPS)
- Thrust: 6,000,000 N
- Propeller Diameter 10 m
- Water Density: 1000 kg/m3

Using the attached B-series data:

a) Find J, Kt, Ct
b) Find Required Pitch P/D for the propeller
c) Find the efficiency and required engine horsepower.
d) Find the Actuator disk efficiency for this propulsor.

Data for Problem 1:

Blades- 3
Meanline type: Parabolic
Thickness type: Elliptical

r/Ro	P/D	xs/D	Skew(deg)	C/D	fo/C	to/D
0.2	1.4387	0.0	0.0	0.174	0.0205	0.0434
0.25	1.5192	0.015	4.647	0.202	0.0326	0.0395
0.3	1.5361	0.01	9.239	0.229	0.0387	0.0358
0.4	1.4792	0.02	18.816	0.275	0.0394	0.0294
0.5	1.3772	0.03	27.991	0.312	0.0349	0.0240
0.6	1.2706	0.04	36.770	0.337	0.0288	0.0191
0.7	1.1416	0.05	45.453	0.347	0.0231	0.0146
0.8	1.0265	0.06	54.245	0.334	0.0181	0.0105
0.9	0.8999	0.07	63.102	0.280	0.0157	0.0067
0.95	0.8009	0.085	67.531	0.210	0.0187	0.0048
1.0	0.6527	0.08	72.000	0.002	0.0263	0.0029