MAE 119: Homework 6

Due: Friday, Mar. 13, 2020

You must show all work for full credit. Joint submissions can be made in groups of two. All submissions and code must be uploaded to Canvas for full credit.

1. **(55 points)** A Darrieus H turbine will be installed at a site where the wind speed is 6 m/s at 10 m, pressure is 1.01 atm and ambient temperature is 16° C. This is a vertical axis wind turbine, with rotor height of 8 m and diameter of 6 m. The center of the turbine is at z =20 m. Determine the following:
   (a) Air density
   (b) Wind speeds at heights of z =16, 20, and 24 m using $\alpha = 1/7$.
   (c) Wind power density using $u(z = 20\ m)$.
   (d) Maximum turbine power output
   (e) Realistic power of a Darrieus H turbine. Look for a power coefficient online. Cite your sources.
   (f) At what angular speed will this turbine be spinning? How long does it take for a full rotation?

2. **(30 points)** Determine the Weibull parameters c and k for an average wind speed of 8 m/s and a standard deviation of 3.7 m/s. If these values are measured at a height of 20 m, estimate the Betz power for a 2-blade horizontal axis wind turbine of diameter 100 m located at a height of 100 m. You might need to use Eq. 24.4.5. Assume $\rho = 1.225$ kg/m^3 at $z = 100$ m, and $\alpha = 1/7$. Assume that the SD grows proportionally in height at the same rate as the wind speed.

3. **(15 points)** Two anemometers installed on a tower have the following wind speed readings at z =10 m and 30 m. Find the power law coefficient α by finding the slope of the best linear fit between the two sets of wind speed readings.

$u(z = 10\ m)$ (m/s)	$u(z = 30\ m)(m/s)$
3.2	4
4.5	5.5
2.9	3.6
5.2	6.4
6.1	7.5
1.5	1.8
4.2	5.2