

Engineering Physics Computing // Spring 2005 Design Project

Due Date: Contest on Friday April 29. Short oral reports will be given prior to the contest. All oral reports must make a prediction of the anemometer rotation rate at the given wind speed.

You will design an anemometer. You will design and build appropriate replacement panels to the UCO Wind Tunnel so that the anemometer and associated measurement equipment may be mounted on the tunnel. You will also conduct tests to arrive at the actual rotation rate versus air speed and plot your results in dimensional and dimensionless form - for the latter plot compare your measured results to the theoretical dimensional analysis results. The results will be presented in class along with final construction drawings, materials list, material costs, and an analysis of the performance of the apparatus.

You will need to construct the anemometer from readily available supplies. A contest will be held on the date mentioned above to determine which team can best predict the rotation rate of their anemometer for a given air speed. Your anemometer must be small enough to fit inside the wind tunnel. Rotation rates will be measured with a rotation sensor – this sensor has a maximum measured rotation rate of 4000 rotations per minute. You should look at how to mount your anemometer to the sensor as well.

See team assignments on the following page.

ENGR 1213 Design Teams for Spring 2005

Team One	
Osburn	Jeff
Thompson	David
Brooks	Ryan
Toth	Richard
JOSHI	CHET
Team Two	
Cross	Douglas
Reser	Daniel
Smith	Zachary
Fleming	Chadd
Pant	Pabin
Team Three	
davis	matt
Rai	Sudarshan
Pollock	Andrew
Robinson	Anthony
Tucker	Jonathan
Team Four	
Bettes	James
Saiyed	Ruhi
Sourelah	Tarik
Bell	Bryce
Mitchem	John
Team Five	
Archer	Bryan
Kiser	Chris
Thompson	Jeremy
Bean	Quincy
Team Six	
Wilson	Justin
Lovato	Zac
Williams	Thomas
Kruckenber	Robert
Lu	Daryn

D5.1 We are given laboratory data, taken by Prof. Robert Kirchhoff and his students at the University of Massachusetts, for the spin rate of a 2-cup anemometer. The anemometer was made of ping-pong balls ($d = 1.5$ in) split in half, facing in opposite directions, and glued to thin ($\frac{1}{4}$ -in) rods pegged to a center axle. (See Fig. P7.91 for a sketch.) There were four rods, of lengths $l = 0.212, 0.322, 0.458,$ and 0.574 ft. The experimental data, for wind tunnel velocity U and rotation rate Ω , are as follows:

$l = 0.212$		$l = 0.322$		$l = 0.458$		$l = 0.574$	
$U, \text{ft/s}$	$\Omega, \text{r/min}$	$U, \text{ft/s}$	$\Omega, \text{r/min}$	$U, \text{ft/s}$	$\Omega, \text{r/min}$	$U, \text{ft/s}$	$\Omega, \text{r/min}$
18.95	435	18.95	225	20.10	140	23.21	115
22.20	545	23.19	290	26.77	215	27.60	145
25.90	650	29.15	370	31.37	260	32.07	175
29.94	760	32.79	425	36.05	295	36.05	195
38.45	970	38.45	495	39.03	327	39.60	215

Assume that the angular velocity Ω of the device is a function of wind speed U , air density ρ and viscosity μ , rod length l , and cup diameter d . For all data, assume air is at 1 atm and 20°C . Define appropriate pi groups for this problem, and plot the data in this dimensionless manner. Comment on the possible uncertainty of the results.

As a design application, suppose we are to use this anemometer geometry for a large-scale ($d = 30$ cm) airport wind anemometer. If wind speeds vary up to 25 m/s and we desire an average rotation rate $\Omega = 120$ r/min, what should be the proper rod length? What are possible limitations of your design? Predict the expected Ω (in r/min) of your design as affected by wind speeds from 0 to 25 m/s.

