Design Project – Wind Turbines

1.0 Objectives

You have been tasked with designing, fabricating, and testing a wind turbine device. The 3 key needs for this device are:

1. **Power:** Produce a high amount of electrical power for the given style of your wind turbine (horizontal, vertical, other).
2. **Durability:** Be durable enough to function in high winds.
3. **Aesthetics:** Be aesthetically pleasing.

2.0 Assessment of Wind Turbine Performance

Power

The average power generated will be assessed by placing your wind turbine in front of a traditional box fan (20"x 20") on the high-speed setting. Your wind turbine can be located anywhere as long as the closest point of your wind turbine to the fan is never less than 1 foot. Power will be measured by recording the voltage across a known resistor. The value of the resistor will be chosen by your team.

Durability

The wind turbine will be expected to withstand the high winds of a leaf blower, placed 13 feet away for 13 seconds. You are allowed to clamp your turbine to the table for this test. This is an extremely high amount of wind that can destroy a poorly balanced or poorly designed device. Teams are encouraged to include design features that prevent damage from high wind speeds.

Aesthetics

The aesthetics will be judged by the lab instructor and/or outside experts. The final beta prototype should appear to be of high quality and professionally built.

3.0 Constraints

Design Constraints

1. Your final prototype must include at least one 3D printed part.
2. Your final prototype must include at least one traditionally machined part (e.g. made on a mill or lathe).
3. No tape is allowed anywhere on the Beta Prototype
4. You cannot purchase wind turbine blades and attach them to your device.
   - 4.1 You cannot use an already created CAD file to 3D print your turbine blade. Similarly you cannot cast a mold directly from an existing turbine blade. However, you can use existing blades for inspiration; taking measurements and physically testing performance. If you do 3D print your turbine blade you must start the CAD drawing with a blank CAD file (you cannot take an already drawn turbine blade and just modify it in CAD).
5. You can only use the supplied electric motor to convert kinetic energy into electrical energy.

Safety Procedures

6. Turbine blades must be positively engaged to the rotating axis. This means that in order for the blades to come off something must physically break, not slip.
7. Teams must always wear safety glasses when a wind turbine is spinning.

Available Resources

8. 3D printing in Reber and library
9. You will have access to materials in 239 Reber or 314 Hammond
10. Items such as nuts and bolts, washers, common fasteners, etc., are available at no cost from the MNE Instrument Room in 23 Reber, as well as the Learning Factory
11. Budget: $20. All purchases will be made through class purchasing form.

4.0 Deliverables and Assessment

The project is worth 60% of your class grade. This 60% comes from written reports and handouts, presentations, and prototype evaluations.

Communication:
Documents will be assessed with rubrics made available before the due date of the assignment

- Research Presentation and Handout: 10% of project grade
- Proposal Presentation and Report: 30% of project grade
- Final Presentation and Report: 20% of project grade

Prototypes:
A series of prototypes will be due in class according to the schedule. Expectations for the prototypes are listed in the rubric sections on the following pages.

- 0'th Prototype: 0% of project grade (journal assignment)
- First Alpha Prototype: 10% of project grade
- Second Alpha Prototype: 10% of project grade
- Beta Prototype: 20% of project grade
    - As mentioned, any team that produces the highest power in their section will be guaranteed an A for the Beta Prototype.

Note: If additional clarifications are needed, they will be made in lecture and updated in this document.

Alpha 1 Prototype Rubric

10	**Power relative to turbine type:** Some amount of electricity can be generated (wind power-based rotation of motor). Motor can be temporarily fixed in place.
10	**Durability:** Solid base should be constructed. The base should be able to withstand the high wind test. Blades may not yet be able to spin at high speeds.
10	**Aesthetics:** Must be able to identify at least 3 components of your wind turbine that are in near finalized form. For example: base, supporting column, and motor bracket. For other components, the use of craft supplies is allowed, including cardboard, tape, hot glue, etc.

Alpha 2 Prototype Rubric

10	**Power relative to turbine type:** Electricity can be generated (wind power-based rotation of motor). Motor and drivetrain components are permanently mounted into place. Wire connections are soldered.
10	**Durability:** The wind turbine should be able to withstand the high wind test.
10	**Aesthetics:** There should be no use of craft supplies, including cardboard, tape, hot glue, etc. Every component should look in a near final form. Only minor improvements to appearance have yet to be made, such as final sanding, rounding corners, the addition of a final housing cover, etc.

Beta Prototype Rubric

10	**Power relative to turbine type:** High power electricity relative to turbine type can be generated. The motor and drive train components are permanently mounted into place. Wire connections are soldered. It is apparent that there are no obvious inefficiencies in the system, including crooked drive train, loose flimsy blades, etc. As mentioned, any team that produces the highest power in their section will be guaranteed an A grade (at least 93%) for the Beta Prototype.
10	**Durability:** The wind turbine passes the high wind test. There are no loose parts on the entire device.
10	**Aesthetics:** Your product contains no tape, glue, cardboard, paper, or other craft supplies. Edges are smoothed and corners are all rounded. Overall, the device looks like a professionally built and finished product.