JOHN EDMONDSON HIGH SCHOOL
Assessment Notification

Faculty: Industrial Arts Course: Engineering Studies Year: 10

Assessment Task: Alternative Energy Practical and Report

Assessment Weighting: 35% Due: Term 2 Week 2 Date: 9/05/2024

Task Type: Hand in Task ☒ In Class Task ☐ Practical Task ☒

Outcomes assessed (NESA)

- **IND5-2** Applies design principles in the modification, development and production of projects
- **IND5-3 -** identifies, selects and uses a range of hand and machine tools, equipment and processes to produce quality practical projects
- **IND5-5 -** selects, interprets and applies a range of suitable communication techniques in the development, planning, production and presentation of ideas and projects

Task Description/Overview

Engineering report on the production of your wind turbine

Detailed Assessment Task Description

You are to **engineer** and **construct** a wind turbine that will generate electricity adhering to the following constraints. You are supplied a electrical generator kit which you are required to solder together, assemble a tower and develop a suitably shaped turbine which will spin to generate the electricity. You will need to research materials and production methods that you plan to use and justify decisions you have made.

Students are to produce an engineering report by documenting the following:

- Identify and research the need or problem
- Develop and select the best possible solutions
- Construct the prototype
- Test and evaluate the solution
- Communicate the solution
- Redesign

Assessment Criteria		
Grade	**Description**	**Mark Range**
Outstanding (O)	• Outstanding design and faultless development of an alternative energy practical project. • Turbine Design has been modified as a result of testing and experimentation. • Outstanding identification and selection of hand tools, machines, equipment and processes to produce quality practical projects • Outstanding communication of the development, planning and production of ideas for the construction of an alternative energy practical project.	**45-50**
High (H)	• Highly accomplished design and quality development of an alternative energy practical project, that may have one or two mistakes. • Turbine Design has as attempted modification as a result of testing and experimentation. • Thorough dentification and selection of hand tools, machines, equipment and processes to produce quality practical projects • Thorough communication of the development, planning and production of ideas for the construction of an alternative energy practical project.	**40-44**
Sound (S)	• Appropriate design and complete development of an alternative energy practical project. The project may have more than two mistakes. • Turbine Design has been modified. • Appropriate identification and selection of hand tools, machines, equipment and processes to produce quality practical projects • Appropriate communication of the development, planning and production of ideas for the construction of an alternative energy practical project.	**30-39**
Basic (B)	• Basic design and development of an alternative energy practical project. The project may have multiple mistakes. • Turbine Design has an attempted modification. • Basic identification and selection of hand tools, machines, equipment and processes to produce quality practical projects. • Basic communication of the development, planning and production of ideas for the construction of an alternative energy practical project.	**15-29**
Limited (L)	• Limited design and development of an alternative energy practical project. Project is presented incomplete. • Limited identification and selection of hand tools, machines, equipment and processes to produce quality practical projects. • Limited communication of the development, planning and production of ideas for the construction of an alternative energy practical project.	**0-14**

Satisfactory completion of courses

A course has been satisfactorily completed, when the student has:

- Followed the course developed/endorsed by the NSW Educational Standards Authority (NESA)
- Applied himself/herself with diligence and sustained effort to the set tasks and experiences provided in the course.
- Achieved some or all of the course outcomes

POWER YOUR HOUSE WITH WIND ENERGY

You will learn how engineers harness the energy of the wind to produce power by following the engineering design process as you prototype a wind turbine and test to see the factors that affect its output. You will also learn how engineers decide where to place wind turbines, and the advantages and disadvantages to using wind power compared to other non-renewable energy sources.

Engineering Connection

Engineers are responsible for developing, designing, testing and improving ways in which electricity is generated for our homes and businesses. One way to generate power is to harness the energy of the wind using a wind turbine. Engineers are responsible for the design, implementation and testing of wind turbines all over the world. Civil, mechanical and electrical engineers work together to determine the most ideal locations for wind farms and the most efficient turbine designs for specific conditions.

Learning Objectives

After this activity, students should be able to:

- Describe how wind turbines transfer the energy of the wind into electricity.
- List several advantages and disadvantages for using wind power.
- Use the engineering design process to create prototype wind turbines.

Introduction/Motivation

- Wind is a terrific renewable energy source because as long as the sun is shining, there will be wind, and as long as there is wind, there is energy. You will build a wind turbine and then test the design to see how it performs. Throughout this process you will follow the same steps that engineers follow in the design process; you will brainstorm ideas, design and build the wind turbines, test them, and analyze the data you collect to make a final decision about which factors affect the performance of the wind turbine.

Design Specifications:

1. You are to construct the wind generator circuitry using the kit provided.
2. You are allowed to use materials found in the workshop or supply your own to build the turbine blades. You will need to take into consideration the weight of the material/s you have chosen to use. Materials from home are allowed to be used and must comply with materials the school is allowed to use. Materials should be recycled materials.
3. The circuitry does not need a cover or enclosure however you can make an aesthetical decision to design and construct one.
4. Wind power received by the environment is the only power source that will be used for generating electricity.
5. You can modify the speed of the turbine blades by experimenting with their size and shape reducing wind resistance.

Engineering Report:

You are to write up an Engineering Report on your findings. To do this, you should follow the Engineering Design Process documented below. This is just a basic guide.

1. **Identify the Need or Problem:**
   - Generate a problem that you are trying to solve by designing wind turbines.
   - Discuss the effects that the construction of a wind turbine has on society and the environment

2. **Research the Need or Problem:**
   - How does wind get generated?
   - How is wind used to generate electricity/energy?
   - What are the factors that affect the efficiency of wind turbine design?
   - Include the type of engineers that are involved in designing wind turbines and what their role is.

3. **Develop Possible Solutions:**
   - Provide 2 sketches of each wind turbine design. This must be neatly drawn using pencil.

4. **Select Best Possible Solution**
   - Draw your final intended design to scale on A4 paper
   - Dimensions and annotations should be labelled on each drawing. Written justifications for all modifications.
   - Your final design should be aesthetically pleasing.

5. **Construct a Prototype:**
   - Layout the method you used in constructing your wind turbine
   - Create a computer-generated model using Onshape
   - A photograph of the final model

6. **Test and Evaluate Solution:**
   - Evidence of testing a range of factors by completing the testing table on page 6.
   - What difficulties did you encounter during the engineering process?

7. **Communicate the solution:**
   - Your solution will be communicated via this engineering report with proper formatting, page numbers BIBLIOGRAPHY and looks aesthetically pleasing.

- Correct bibliography structure <u>WEBSITE:</u>

Author, A. A. (year of publication). Title of web page. Retrieved from: URL

EG: Horn, R. (2010). Biofuels. Retrieved from http://www.nrel.gov/learning/re_biofuels.html

8. **Redesign:**
   - How can you improve the design based on the things you learned from testing
   - Any modifications made are justified

TESTING THE TURBINE BLADES

The way they are designed will have a huge impact on how well the turbine works. As you build your turbine, you should perform experiments to see which blades work best. Some blade variables you might want to test include length, shape, number, materials, pitch, and weight.

Here are some quick tips on improving your blades if things are not working as you expect:

• Shorten Blades.
Many times, students make very long blades, thinking bigger is better. While that is sometimes true, beginners have a hard time making long blades without adding drag. Try shortening them a few centimetres to see what might happen.

• Change the pitch.
Pitch dramatically affects power output. Often, students set the angle of their blades to around 45° the first time they use the turbine. Play with it a bit and see what changes. What happens when you make the blades more perpendicular to the wind flow?

• Not spinning?
If you have your blades attached, and they are not spinning, check the pitch of the blades. Are your blades oriented in the same direction? Are they flat? Are the blades hitting the tower?

• Use fewer blades.
To reduce drag, try using fewer blades.

• Use lighter material.
To reduce the weight of the blades, use less material or lighter material.

• Use stiffer material.
If your blades are bending in the wind or deflecting when the wind hits, you might want to find a stiffer material.

• Smooth surfaces.
Smoother blade surfaces experience less drag. A blade with lots of tape and rough edges will have more drag.

• Get more wind.
Make sure you are using a decently sized box or room fan, one with a diameter of at least 35–45cm.

• Blades versus fan.
Are your blades bigger than your fan? This could be a problem, as the tips of your blades are not catching any wind and are just adding drag.

• Blade shape.
Are the blade tips thin and narrow or wide and heavy? The tips travel much faster than the roots. Generally, this means that wide tips add drag.

On the next page, keep a record of the testing you have done and what improvements you have made as a result of the testing.

Testing:

What are you testing?	How did you conduct the experiment?	What was the result?	What are you going to change as a result of the test?

MARKING CRITERIA:

Identify Need or Problem	Excellent in-depth discussion of the effects of constructing a wind turbine on society and environment. **(10 marks)**	Reasonable discussion on the effects of constructing a wind turbine on society and environment. **(8 marks)**	Brief discussion on the effects of wind turbine construction on society and environment. **(6 marks)**	Provides only positive or negative effects on wind turbine construction on society and environment. **(4 marks)**	Brief mention of positive or negative effects on wind turbine construction on society and environment. **(2 marks)**
Research	An in-depth response to the 4 dot points **(10 marks)**	An in-depth response to 3 dot points **(8 marks)**	An in-depth response to 2 dot points **(6 marks)**	A brief response to the 3-4 dot points **(4 marks)**	A brief response to 2 or less dot points **(2 marks)**
Possible Solution		Provides 2 neatly drawn sketches **(4 marks)**	Provide 2 rough sketches of design **(3 marks)**	Provide 1 neatly drawn sketch **(2 marks)**	Provides 1 rough sketch of design **(1 mark)**
Best Possible Solution				Provides a well-drawn to scale design on A4 or A3 paper with annotations **(3 marks)**	Provides a messy and not to scale design with/without annotations **(1-2 marks)**
Prototype Construction		Well written and step by step method with a picture of final model attached **(4 marks)**	Adequately written and step by step method with picture of final model attached **(3 marks)**	Brief method with a picture of final model attached **(2 marks)**	No method written and picture of final model attached **(1 mark)**
Test and Evaluate solution		Well written account of the difficulties you encountered. Multiple tests conducted. **(4 marks)**	Brief account of the difficulties you encountered. Couple tests conducted. **(3 marks)**	Brief account of difficulties and single test conducted. **(2 marks)**	Brief account of difficulties and no test conducted. **(1 mark)**
Communicate solution				Presentation follows report guidelines and is well laid out Communication uses diagrams, pictures & is well referenced. **(5 – 10 marks)**	Inaccurate de of an engineering report with no diagrams and references **(1-4 marks)**
Redesign	Multiple in-depth methods of how the design can be improved after testing **(5 marks)**	Multiple brief methods of how the design can be improved after testing **(4 marks)**	1 In-depth method of how to improve design after testing **(3 marks)**	1 brief method of how to improve design after testing **(2 marks)**	Attempts to give a method of how to improve design after testing **(1 mark)**
				TOTAL	**/50**