T.C.
ANKARA YILDIRIM BEYAZIT UNIVERSITY
FACULTY OF ENGINEERING AND NATURAL SCIENCES
ENERGY SYSTEMS ENGINEERING DEPARTMENT

ESE – 40… ENERGY SYSTEMS LABORATORY -…
Wind Turbine Experiment Report

Student ID Number:

Name Surname:

Experiment Date:

Grade:

WIND POWER

It is quite difficult to imagine that air is a fluid. Because air is invisible. Unlike liquids, air moves faster and covers every part of its environment. With the rapid displacement of the air, the movement of the particles in it also becomes rapid. The process of converting this property of the air into kinetic energy is called Wind Energy.

With the same logic, obtaining energy by using the displacement feature of liquid substances such as water is called hydro electricity and the center produced is called Hydro Electric Power Plant. Centers that produce electricity from wind energy are called Wind Power Plants.

After Wind Power Plants are installed, the propellers rotate the shaft to which they are attached by the movement of the wind (air). This kinetic energy is converted into electrical energy with a suitable generator.

Wind energy starts with the sunrise. The parts of the cold air layer that forms at night, close to the ground, immediately begin to warm up with the sun's rays. As you may remember from physics lessons, heated air expands and rises. At this moment, the cold air layer in the atmosphere descends towards the ground. Wind is formed by the exchange of hot and cold air.

Wind turbine

In the simplest sense, a wind turbine consists of 3 parts.

1. Propeller Blades:

When the wind blows, it hits the blades of the propeller and starts to rotate it. In this way, kinetic (motion) energy is obtained with wind energy. Propellers are designed to rotate in the same direction when the wind blows.

2. Shaft:

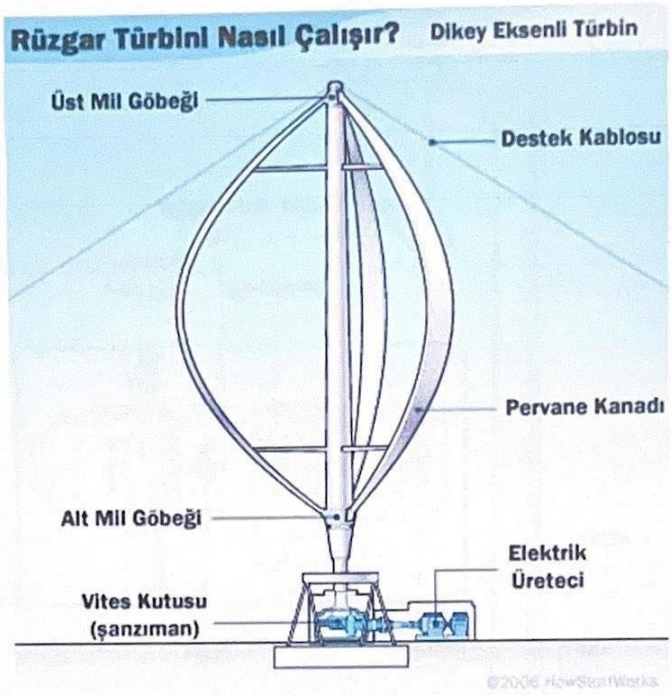
As the parvenes rotate, the shaft connected to it also begins to rotate. As the shaft rotates, movement occurs within the motor and electrical energy is provided at the output of the motor.

3.Generator:

It has a very simple working method. Electrical energy is produced by electromagnetic induction. It is a system similar to the electric motor in small toy cars. It contains magnets. In the middle of these magnets, there is a section wrapped with thin wires. When the propeller shaft rotates, this winding area in the motor begins to rotate in the middle of the magnets around it. As a result, alternating current (AC) is formed.

Modern Wind Turbine Technology

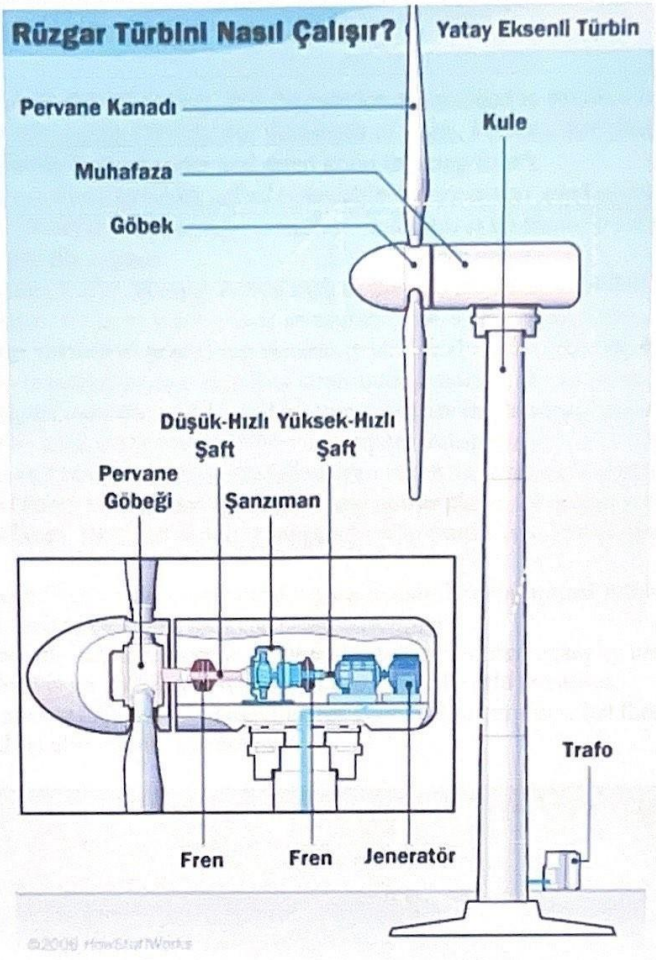
Wind turbines today come in two different designs. The first of these is the design that can rotate around the vertical axis, as you see in the photo below.



It is called VAWTs, that is, "Vertical Axis Wind Turbine".

It is designed so that its vertical axis is perpendicular to the ground. It is always adjusted according to the direction of the wind. There is no need to adjust the horizontal axis according to the wind. Generally, it requires an electric motor as the first move. The turbine is fixed from its axis with auxiliary wires. The efficiency of the device is low as there is less wind in places close to sea level.

Another important design is called Vertical Axis Wind Turbine (HAWTs) "Horizontal Axis Wind Turbine". The rotation axis is designed parallel to the ground. The direction of the propeller can be adjusted according to the wind direction with the help of an electric motor. Structurally it does not differ from an electric motor. In order to operate efficiently, it must be approximately 80 meters above sea level.



Rotor Blades : It is used to convert wind energy into rotational motion.

Shaft : It transmits the rotational movement to the generator.

Gear Box : It increases the speed between the propeller and the shaft and helps transmit a faster movement to the generator.

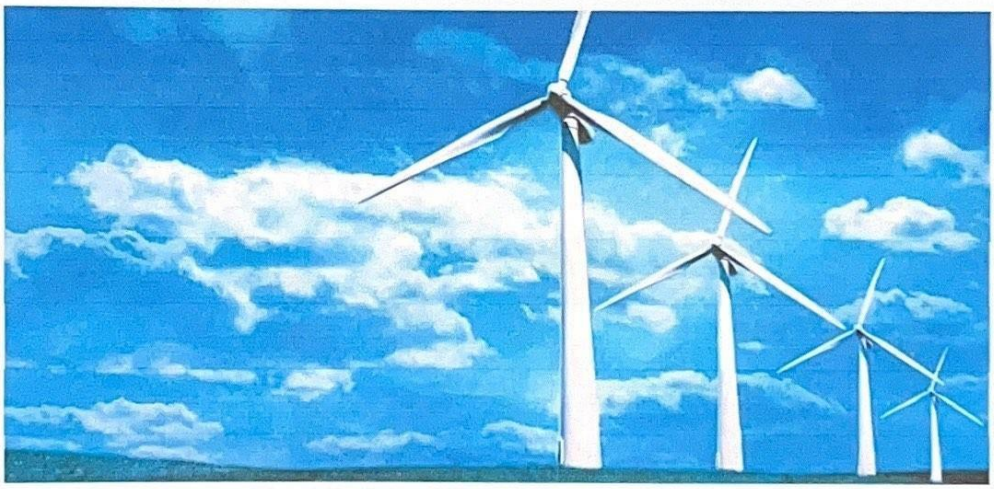
Generator : The part that produces electrical energy from rotational motion.

Breaks : It is used to stop the propeller in case of overload or a problem.

Electrical Equipment : It ensures that the generated electrical energy is transmitted to the relevant centers.

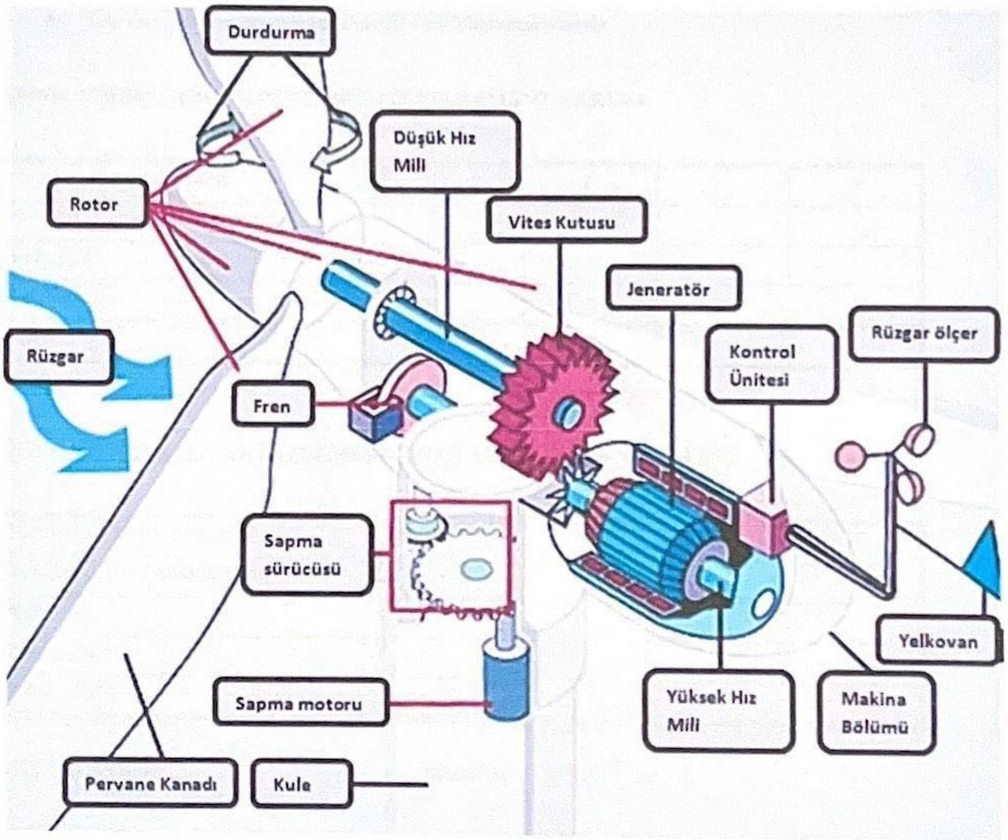
Advantages of wind energy:

1. Wind energy is not a new discovery. It is the best known method to produce mechanical energy using kinetic energy (Wind). For thousands of years, Persians and later Romans have been using windmills to draw water and grind grain (making flour).
2. The meaning of wind energy being called renewable energy is that wind is constantly produced on our planet and this energy is endless, and there is no obstacle for people to use it by transferring it to the system.
3. Wind energy is cheap. Considering factors such as the manufacturer, distribution network and installation location, it can be produced at an average of 4-6 cents/kwh (USA).
4. sing Wind Energy instead of generating electricity with coal means reducing the gases released into the environment and therefore contributing more to the environment.
5. Wind is available all over the world, maybe some countries or places get more wind, but generally it can be used everywhere. It does not require transportation to obtain energy like Natural Gas, oil and coal, so it can be installed even in the most remote corners.
6. In general, wind farms take up less space than coal power plants. Although some people are against wind turbines, there are certainly no people who want a coal power plant behind their house.
7. Wind turbines can fit any environment and use agricultural fields, animal fields. Wind turbines do not need to be alone, they can share their space.
8. Wind energy provides an advantage in providing electricity to the region by installing it in places where there is no grid, in the mountains and in third world countries.
9. Wind turbines are not only used and required for commercial purposes, but their use for household needs is also rapidly increasing.



Disadvantages of Wind Turbines:

1. Wind energy is not a continuous or balanced energy source, therefore it provides unbalanced power to the grid. Turbines are damaged in installations where hurricanes occur, such as the American Gulf region, when the wind is very strong.
2. For some people, it spoils their view. The images are not good.
3. Although there are government incentives and tax deductions, the high initial investment cost and return on investment are a problem.
4. The fact that it is generally far from residential areas creates a connection problem to the network.
5. More research and development is needed to use batteries, hydrogen or other systems to store the energy produced in wind turbines.
6. Some environmentalists think that large-capacity wind turbines will change the flight paths of migratory birds. Wind power is not the same in every region and country. Therefore, wind maps with more accurate measurements are needed.
7. Depending on the type of wind turbine, living or working near it can be a difficult factor due to the noise generated.
8. Although the costs of electricity production with wind energy have decreased, it still does not have an advantage over the low costs of production with fossil fuels.
9. Large capacity wind farms may cause TV signal degradation in the area around 2-3 km.



A) EXPERIMENT NO: YE-1050.1-01

B) THE NAME OF THE EXPERIMENT: **Examining the variation of the output power of the wind turbine at idle and under load with input power and number of revolutions.**

C) PURPOSE OF THE EXPERIMENT: Examining the current-voltage relationship of the wind turbine under load

D) REQUIRED TOOLS AND DEVICES

- cable connection jacks

E) EXPERIMENTAL PROCEDURE:

1. Turn on the fuses, main switch and emergency button on the power unit.
2. Construct the wind turbine electrical cable connections according to the image below.
3. Plug the speed sensor connection cable on the wind turbine into the socket under the tachometer.
4. Make the ground connection of the asynchronous motor.
5. Operate the wind turbine without load via the motor driver and measure the turbine speed voltage values and record them in the table.
6. Apply the load connection diagram below using jack cables.
7. Operate the wind turbine with the load connected via the motor driver and measure the turbine speed voltage values and record them in the table.
8. Record the measurement values in the table.
9. You can perform experiments at different alternator speeds.

WIND TURBINE IDLE OPERATION MEASUREMENT VALUES

Number of measurements	1	2	3	4
Number of Revolutions (rpm)				
Volt, (U)				
Amper, (I_c)				
Power (P) W				

WIND TURBINE OPERATION UNDER LOAD MEASUREMENT VALUES

Number of measurements	1	2	3	4
Number of Revolutions (rpm)				
Volt, (U)				
Amper, (I_c)				
Power (P) W				

CALCULATION: power input: P=U*I (W)