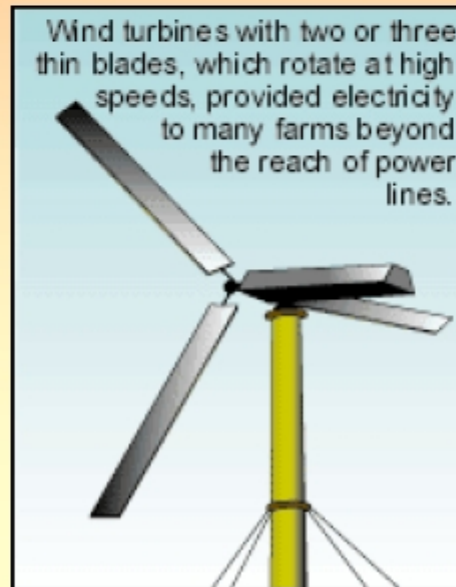# Wind Generation

History of Wind-Mills:

➢ The wind is a by-product of solar energy. Approximately 2% of the sun's energy reaching the earth is converted into wind energy.

➢ The surface of the earth heats and cools unevenly, creating atmospheric pressure zones that make air flow from high- to low-pressure areas.

➢ The wind has played an important role in the history of human civilization .

➢ The first known use of wind dates back 5,000 years to Egypt, where boats used sails to travel from shore to shore.

Wind Generation-1

➤ The first true windmill, a machine with vanes attached to an axis to produce circular motion, may have been built as early as 2000 B.C.

➤ In ancient Babylon. By the 10th century A.D., windmills with wind-catching surfaces having 16 feet length and 30 feet height were grinding grain in the areas in eastern Iran and Afghanistan.

➤ The earliest written references to working wind machines in western world date from the 12th century.

➤ These too were used for milling grain. It was not until a few hundred years later that windmills were modified to pump water and reclaim much of Holland from the sea.

Wind Generation-3

➢ A typical modern windmill looks as shown in the following figure.

➢ The wind-mill contains three blades about a horizontal axis installed on a tower.

➢ A turbine connected to a generator is fixed about the horizontal axis.

Wind turbines with two or three thin blades, which rotate at high speeds, provided electricity to many farms beyond the reach of power lines.

Main Components of a wind-mill

➢ Following figure shows typical components of a horizontal axis wind mill.
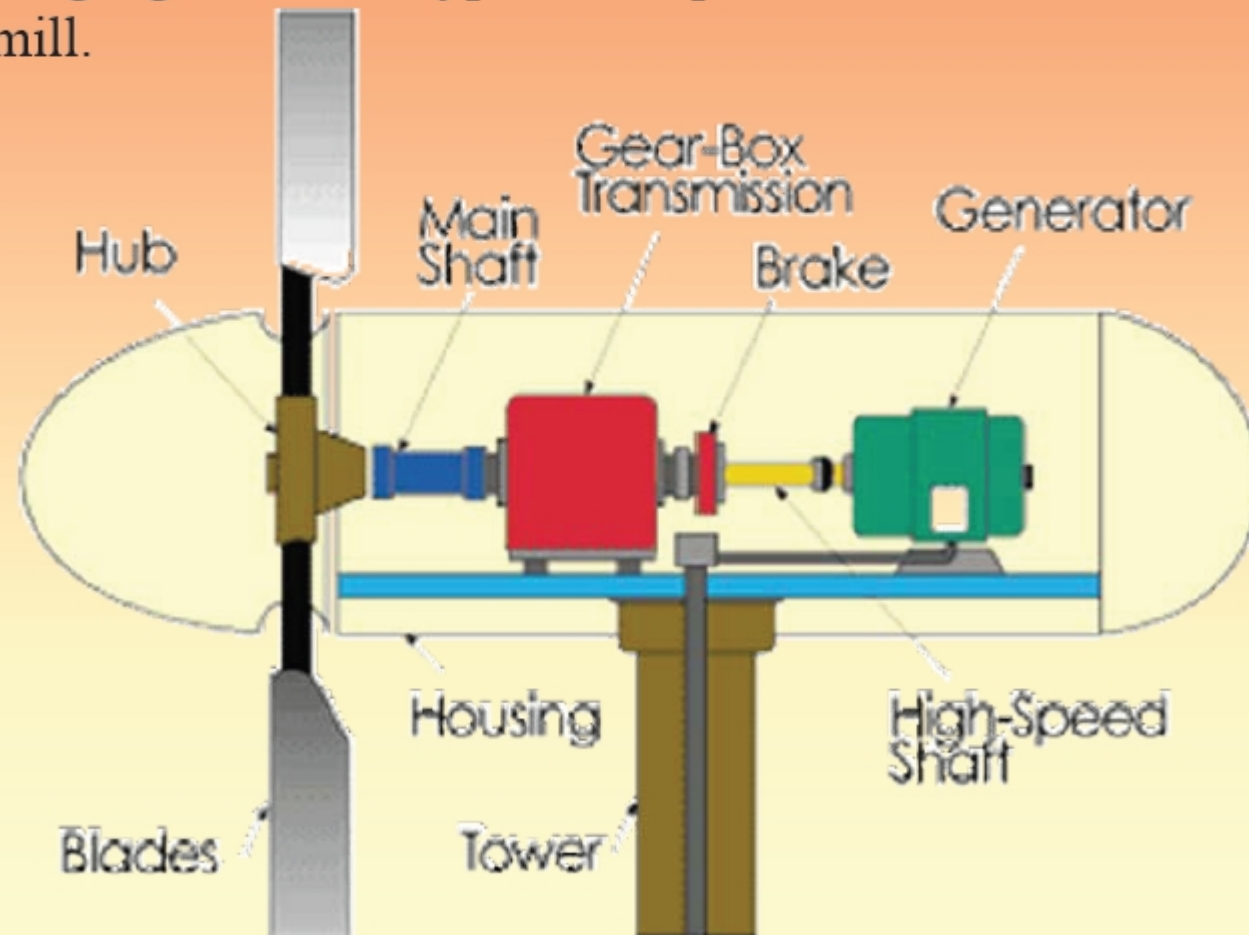
Mathematical Expression Governing Wind Power-1

$$\frac{1}{2} \cdot \frac{d}{dt}\{m \cdot v^2\}$$

$$\frac{1}{2} \cdot \frac{d}{dt}\{\rho \cdot Q \cdot v^2\}$$

$$\frac{1}{2} \cdot \rho \cdot \frac{dQ}{dt} \cdot v^2$$

Here, $\dfrac{dQ}{dt}$ = Rate of discharge (m³/s) = A (m²) • v (m/s)

Where, A = Area of cross section of blade movement.

$$Power = \frac{1}{2} \cdot \rho \cdot A \cdot v^3$$

Wind Energy Regions in India-10