UNIT V

ALTERNATE ENERGY STORAGE TECHNOLOGIES

FLYWHEEL

A **flywheel** is a mechanical energy storage device used to **store rotational energy**. It helps in maintaining a **uniform speed** by resisting fluctuations in motion. Flywheels are widely used in engines, machines, and energy storage systems.

Principle

The working principle of a flywheel is based on **angular momentum** and **energy storage**.

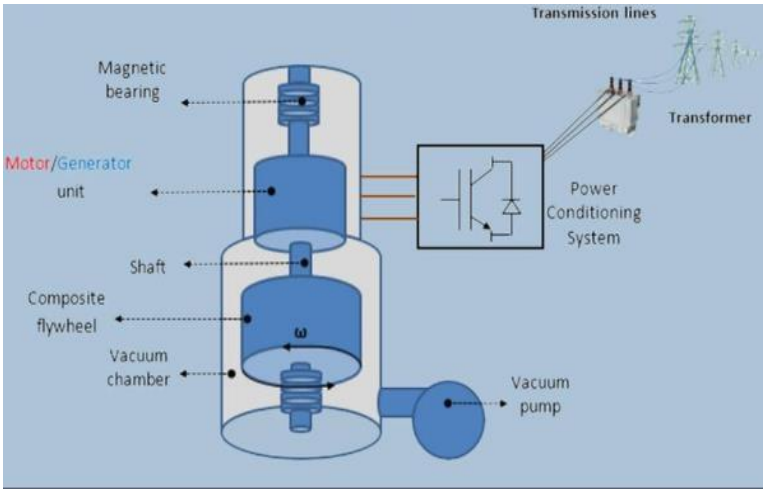
- When excess energy is available → flywheel **stores energy** by increasing speed
- When energy is deficient → flywheel **releases energy** by decreasing speed
- **Energy stored** in a flywheel:

$$E=1/2I\omega^2$$

Where:

E= Energy Stored
I = Moment of inertia
ω = Angular velocity

- A larger **moment of inertia** means more energy storage.
- A heavy rotating rotor is accelerated by an electric motor, which acts as a generator on reversal, slowing down the disc and producing electricity.



Flywheels store energy using the following methods:

1. Mechanical Flywheels

- Made of steel or cast iron
- Used in engines and machinery

2. High-Speed Flywheels

- Made of composite materials
- Operate at very high speeds
- Store more energy with less weight

3. Magnetic Bearing Flywheels

- Reduce friction using magnetic levitation
- Improve efficiency and lifespan

Advantages

- Very fast charge/discharge.
- Long cycle life
- very low maintenance.
- High power density.

Disadvantages

- Short duration storage (seconds to minutes).
- **High cost** for large energy capacities.
- **Safety concerns** due to high speed rotation

Applications

1. In Internal Combustion Engines

- Used in engines like those in vehicles
- Smoothens power output

2. Energy Storage Systems

- Stores renewable energy (solar, wind)
- Provides backup power

3. Industrial Machines

- Used in presses, punching machines, rolling mills
- Maintains constant speed

4. Power Generation

- Stabilizes turbines in power plants

5. Transportation Systems

- Used in modern Kinetic Energy Recovery Systems (KERS)
- Found in high-performance vehicles