SNS COLLEGE OF TECHNOLOGY
(An Autonomous Institution)

Department of Aerospace Engineering

23AST101-Fundamentals of Aerospace Engineering

UNIT-4:
POWER PLANTS

PISTON ENGINE

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Piston engines, also known as **reciprocating engines**, are internal combustion engines that convert fuel into mechanical energy through the reciprocating (back-and-forth) motion of pistons inside cylinders. They are widely used in automobiles, aircraft, motorcycles, and industrial machinery.

1. Working Principle of Piston Engines

Piston engines operate based on the **Otto cycle** (for gasoline engines) or the **Diesel cycle** (for diesel engines). The basic working involves four strokes (hence the name **four-stroke engine**), though some engines use a **two-stroke** cycle.

Four-Stroke Engine Operation

Intake Stroke

The intake valve opens.

The piston moves downward, creating a vacuum that draws in an air-fuel mixture (gasoline engines) or just air (diesel engines).

Compression Stroke

Both valves close.

The piston moves upward, compressing the air-fuel mixture (or just air in diesel engines).

Compression increases temperature and pressure.

Power (Combustion) Stroke

Gasoline Engine: A spark plug ignites the compressed air-fuel mixture.

Diesel Engine: Fuel is injected into hot compressed air, causing spontaneous ignition (no spark plug needed).

The explosion forces the piston downward, generating power.

Exhaust Stroke

The exhaust valve opens.

The piston moves upward, pushing out burnt gases.

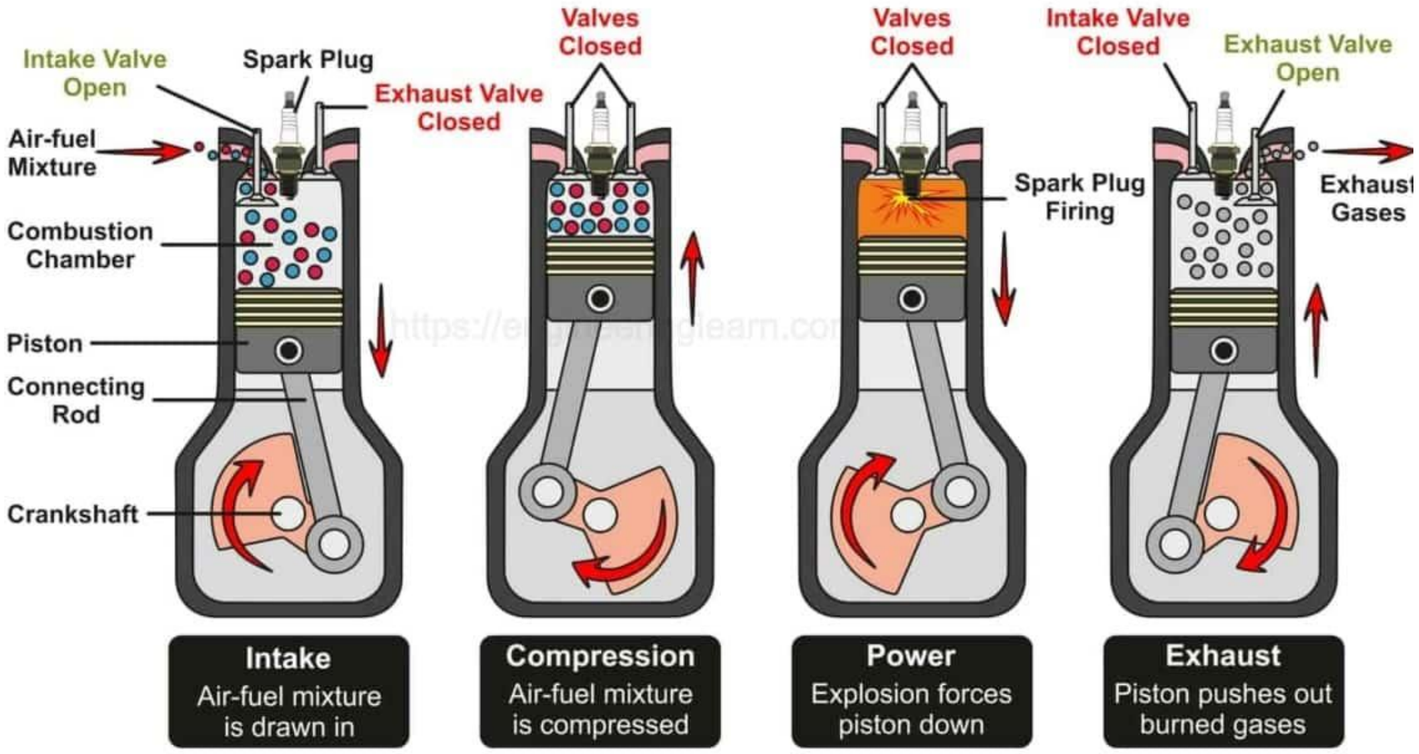
This cycle repeats continuously to produce rotational motion via the crankshaft.

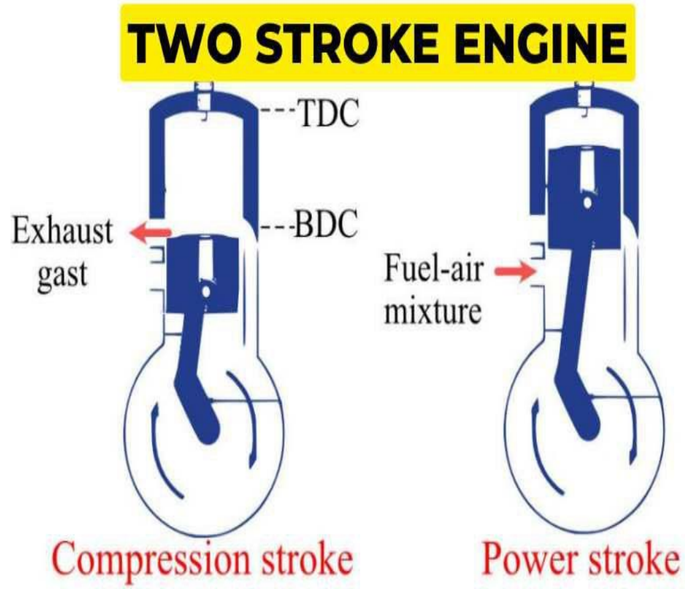
Two-Stroke Engine Operation

Combines intake, compression, power, and exhaust into **two strokes** (one upstroke and one downstroke).

Simpler but less efficient and more polluting than four-stroke engines.

Used in small engines (e.g., chainsaws, mopeds).





2. Classification of Piston Engines

Piston engines can be classified based on several factors:

A. Based on Ignition Type

Spark Ignition (SI) Engines

- Use a spark plug to ignite the air-fuel mixture.
- Run on gasoline or other volatile fuels.
- Example: Most car engines.

Compression Ignition (CI) Engines

- No spark plug; fuel ignites due to high compression.
- Run on diesel fuel.
- Example: Truck and heavy machinery engines.

B. Based on the Number of Strokes

Four-Stroke Engines

- More efficient, cleaner, and widely used in cars and aircraft.
- Completes one power cycle in four piston movements.

Two-Stroke Engines

- Simpler, lighter, but less efficient and more polluting.
- Used in small applications like lawnmowers and motorcycles.

C. Based on Cylinder Arrangement

Inline Engine

Cylinders arranged in a straight line.

Simple design, common in cars (e.g., 4-cylinder engines).

V-Engine

Cylinders arranged in a V-shape (e.g., V6, V8).

More compact, higher power output.

Opposed (Boxer) Engine

Cylinders lie flat and oppose each other.

Lower center of gravity, used in Subaru and Porsche cars.

Radial Engine

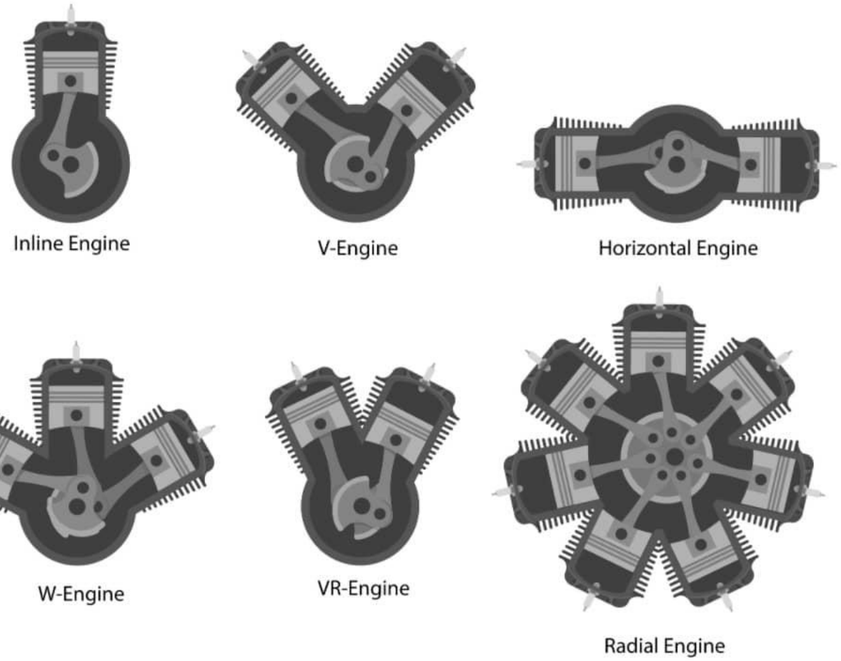
Cylinders arranged in a circle around the crankshaft.

Used in vintage aircraft.

Wankel (Rotary) Engine

Uses a rotor instead of pistons (technically not reciprocating but often grouped with piston engines).

High power-to-weight ratio but poor fuel efficiency.



D. Based on Fuel Type

Gasoline Engines

Use spark ignition, lighter fuel.

Higher RPMs, less torque.

Diesel Engines

Use compression ignition, heavier fuel.

More torque, better fuel efficiency.

Alternative Fuel Engines

Can run on CNG, LPG, ethanol, or hydrogen.

E. Based on Cooling Method

Air-Cooled Engines

Use fins and airflow for cooling (e.g., old Volkswagen Beetle).

Liquid-Cooled Engines

Use coolant and a radiator (most modern engines).

3. Advantages & Disadvantages

Advantages:

✓ Simple and reliable design.

✓ High power-to-weight ratio (especially in aviation).

✓ Can run on multiple fuels.

Disadvantages:

✗ Lower thermal efficiency compared to turbines.

✗ More moving parts → higher maintenance.

✗ Vibrations and noise due to reciprocating motion.

4. Applications

Automobiles (cars, trucks, motorcycles).

Aircraft (piston-engine propeller planes).

Marine (boats and ships).

Industrial Machines (generators, pumps).


THANK YOU!