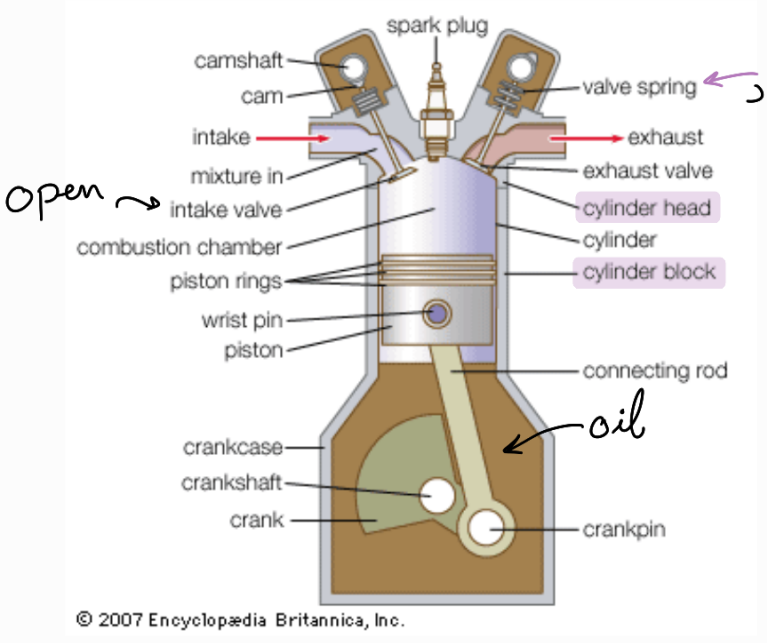
Chapter 1 : Introduction

ICE: an open circuit, non cyclic, quazi steady flow, work producing device



- Parts of the engine :

1. Block : • Body of engine
   • Made from → cast iron (in diesel engines)
   → Aluminum (in gasoline)

2. Cylinder : Contains the piston

3. Head : • Closes the end of cylinders
   • Contains part of the clearance volume

4. Piston • Usually made of Aluminum alloys

5. Combustion chamber: • between the head & the piston
• Minimum volume of cc is at TDC
• Maximum volume of cc is at BDC

6. Cam shaft: • Rotating shaft used to push open valves at a specific time directly or through mechanical or hydraulic linkage (push rods, rocker arms, tappets)

7. Crankshaft: • Rotating shaft that supplies engine work to external systems
• Balance weights are used to reduce vibration

8. Connecting rod: • Connects the piston to crankshaft
• converts linear motion into rotational motion / made of nickel, chrome & vanadium steels (chrome)

9. Piston rings: • Compression rings & oil rings
(oil rings: removes excess oil & lubricates)

10. Crankcase: has oil

11. Exhaust-manifold: • carries exhaust gases away from the engine / made of cast iron

12. Intake manifold :
- Delievers incoming air to the cylinders/ made of cast metal, plastic
- Each cylinder has its pipe & its called a runner

13. Spark plug :
- used in SIE
- Creates high voltages $(15-20)\times10^3$ volts

14. Fuel injector :
- Sprays fuel

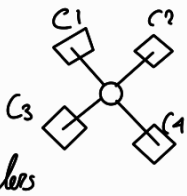
15. Fuel pump :
- Electrical or mechanical

16. Glow plug :
- Electrical resistance heater
- Preheats the chamber in CIE for engine cold start

17. Flywheel :
- Rotating mass
- Stores energy and furnish large angular momentum that keeps the engine rotating between power strokes
- Smooths out engine operation

18. Starter : Electric motor geared to the engine flywheel

Multi Cylinder Shapes



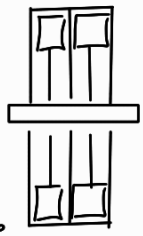
In line
Cylinders arranged linearly (The Basic) shape

V
Two inclined Cylinder banks (one crank shaft)

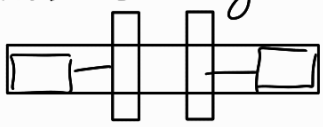
Radial
More than 2 cylinders around the crank shaft.

Internal combustion engine Shapes

Opposed Cylinder
Banks located in the same plane in opposite sides (same crankshaft)



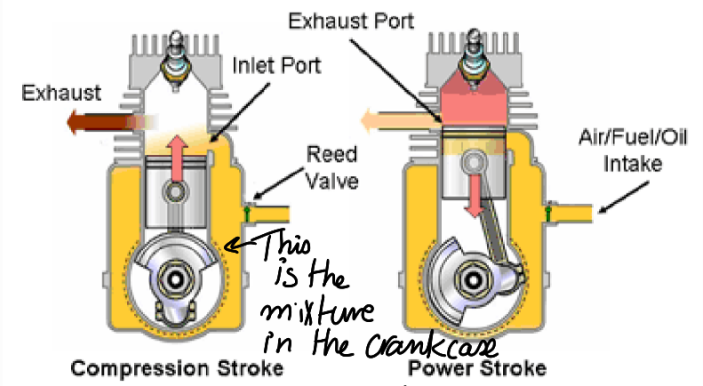
Opposed piston
Two pistons with separate crankshaft in the same cylinder



Comparison between 4-Stroke engine and 2-Stroke engine

Two Stroke engine

- It has one piston
- There is an inlet, outlet ports & a spark plug



Piston moves upward → Combustion chamber gets smaller → Air/fuel mixture compressed → T, P rises → Combustion
Piston moves down → Power

4-stroke engine

Intake → Compression → Exhaust-power

- **Intake**: Inlet valve open, mixture enters
- **Compression**: Inlet valve closed, mixture compressed
- **Combustion (Power)**: piston is pushed after spark
- **Exhaust**: piston is up, exit valve is opened

Four-stroke engine	Two-stroke engine
1. Four stroke of the piston and two revolution of crankshaft- For one thermodynamic cycle	Two stroke of the piston and one revolution of crankshaft
2. One power stroke in every two revolution of crankshaft	One power stroke in each revolution of crankshaft
3. Heavier flywheel due to non-uniform turning movement	Lighter flywheel due to more uniform turning movement
4. Power produce is less Theoretically	power produce is twice than the four stroke engine for same size = more power strokes
5. Heavy and bulky : more components	Light and compact
6. Lesser cooling and lubrication requirements Why?	Greater cooling and lubrication requirements since oil burns with fuel
7. Lesser rate of wear and tear	Higher rate of wear and tear due to poor lubri
8. Contains valve and valve mechanism	Contains ports arrangement
9. Higher initial cost	Cheaper initial cost & higher fuel consumption
10. Volumetric efficiency is more due to greater time of induction	Volumetric efficiency less due to lesser time of induction + Exhaust effective volume is less
11. Thermal efficiency is high and also part load efficiency better	Thermal efficiency is low, part load efficiency lesser
12. It is used where efficiency is important. Ex-cars, buses, trucks, tractors, industrial engines, aero planes, power generation etc.	It is used where low cost, compactness and light weight are important. scooters, motor cycles, propulsion ship etc.

13. Thermal stresses are higher since it heats and cools a lot during operation

$$\eta_{Thermal} = \frac{W}{H}$$

↳ in H.V

fuel is more efficient since rates are used
consump

However, in 2 strokes, fuel is lost due to parts