AKTU

B. Tech I-Year

Gateway Classes

Semester -I & II

Common to All Branches

Fundamentals of Mech. Engg.(BME101/201)

Unit-2 : ONE SHOT-IC Engines & EVs

Gateway Series for Engineering

- Topic Wise Entire Syllabus
- Long - Short Questions Covered
- AKTU PYQs Covered
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AKTU

B. Tech I-Year

Gateway Classes

Fundamentals of Mech. Engg.(BME101/201)

Unit-2

Introduction to IC Engines & EVs

Syallbus

IC Engine: Basic definition of engine and Components, Construction and Working of Two stroke and four stroke SI & CI engine, merits and demerits, scavenging process; difference between two-stroke and four stroke IC engines and SI and CI Engines

. **Electric vehicles and hybrid vehicles:** Components of an EV, EV batteries, chargers, drives, transmission and power devices. Advantages and disadvantages of EVs. Hybrid electric vehicles, HEV drive train components, advantages of HV.

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AKTU B.TECH I-YEAR FME

GATEWAY CLASSES

FUND. OF MECHANICAL ENGG.

FINAL REVISION + NOTES

UNIT-2 IC ENGINES AND ELECTRIC VEHICLES

QUESTIONS तो यहीं से आएंगे !

LIVE TODAY 9 PM

BY M S TOMER SIR

Unit-2: Introduction to IC Engines and Electric Vehicles

Syllabus

IC Engine:

- Basic definition of engine and Components of engine
- Construction and Working of Two stroke and four stroke SI & CI engines
- Merits and demerits, scavenging process;
- Difference between two-stroke and four stroke IC engines
- Difference between SI and CI Engines

Electric vehicles and hybrid vehicles:

- Electric vehicles and its Components
- Advantages and disadvantages of EVs
- Hybrid electric vehicles and its Components
- Advantages and disadvantages of HEVs
- EV batteries, Chargers, drives, transmission and power devices., HEV drive train components

Engine : definition

- It is a device which converts one form of energy into another form of useful energy.

Based on combustion engines are classified into

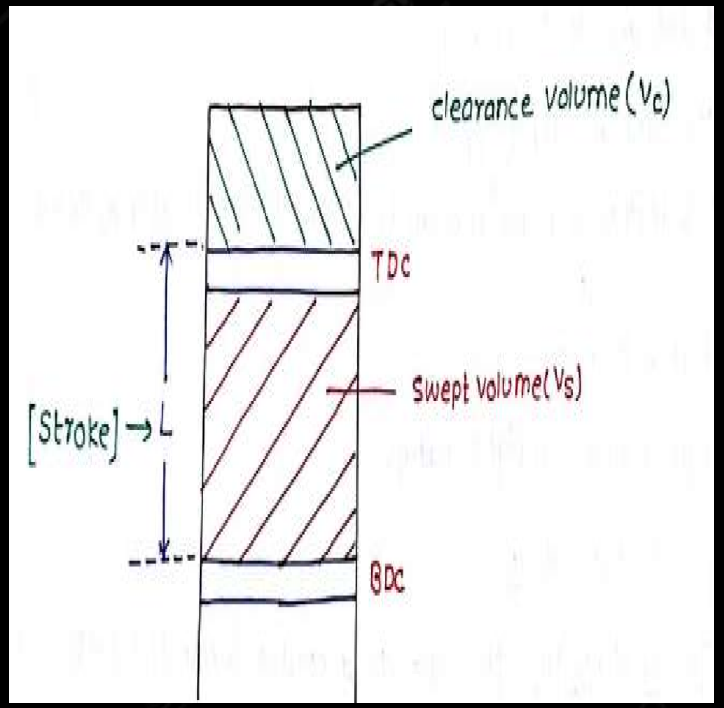
- Internal Combustion Engine (I.C. Engine)
- External Combustion Engine (E.C. Engine)

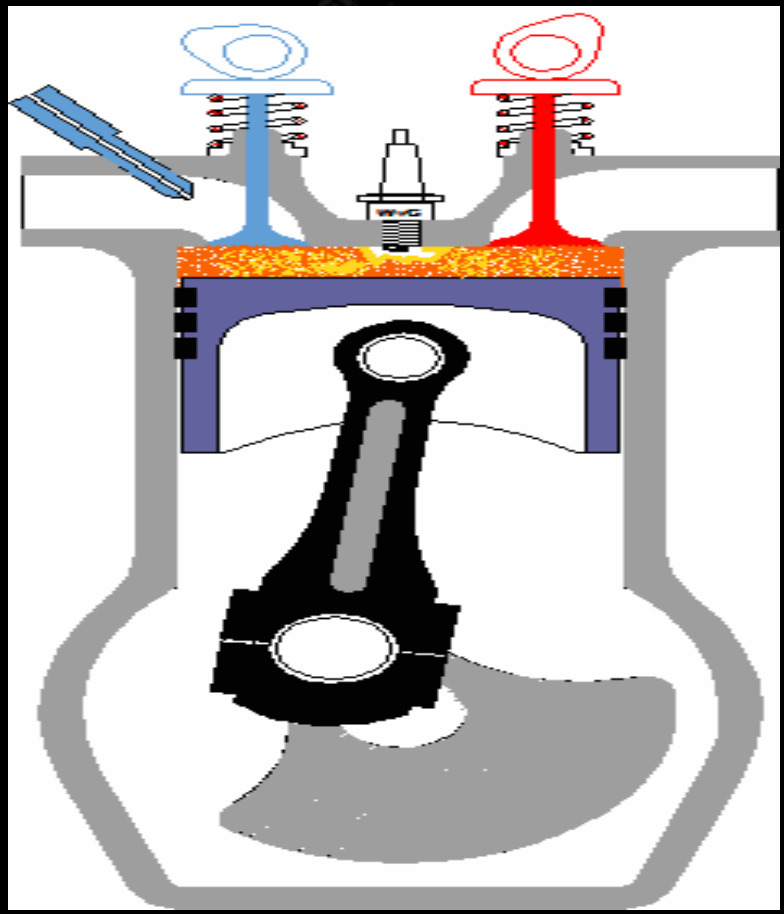
Internal Combustion Engine [AKTU : 2020-21]

- In internal combustion engine the burning or combustion of the fuel takes place inside the cylinder.

Example- Automobile Engines

- Petrol engine
- Diesel engine





AKTU : B.Tech. II SEMESTER

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Sem-II

Session: 2023-24

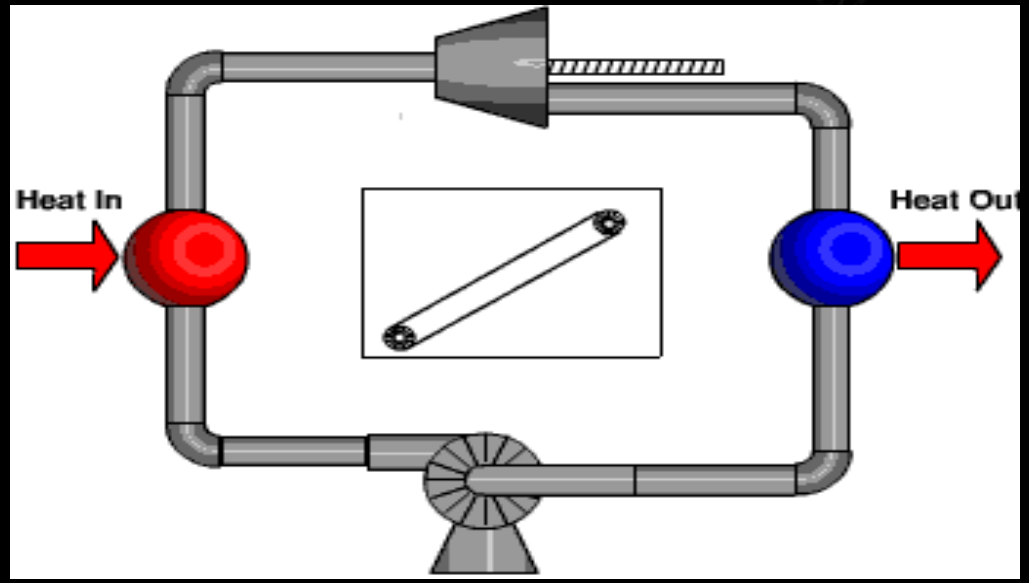
Subjects	
Maths-II	COMBO PACK
PPS/FME	
Electrical / Electronics	
Physics / Chemistry	
Soft Skills / Environment	

Courses will be available 22 March 2024

External Combustion Engine

- In external combustion engine the combustion of the fuel takes place **outside** the engine.

Example- **Steam Engine, Closed gas turbine etc.**



Differences between ICE and ECE

S. No.	EC Engine	IC Engine
1	Combustion of fuel is outside the engine	Combustion of fuel is inside the engine
2	Bulky due to presence of auxiliary apparatus like boiler and condenser.	It is light and compact
3	High ratio of weight to power output	Low ratio of weight to power output
4	It can use cheaper fuels including solid fuels	High grade fuels are used with proper filtration
5	Higher requirement of water for dissipation of heat	Lesser requirement of water
6	Lower efficiency about 15-20%	Higher efficiency about 35-40%
7	Silent operation due to outside combustion	Very noisy operated engine

Advantages of an I.C. Engine

GATEWAY CLASSES

These are the following advantages of an I.C. Engine

1. Mechanical Simplicity
2. Low initial cost due to absence of boiler, turbine condenser etc.
3. High efficiency than external combustion engine
4. Power to weight ratio is high
5. Very suitable for small power requirement applications
6. Starting time is very less
7. Requires less maintenance

Dis-advantages of an I.C. Engine

GW
GATEWAY CLASSES

These are the following disadvantages of an I.C. Engine

1. Variety of fuels that can be used is limited to very fine quality gaseous and liquid fuel.
2. Fuel used is very costly like gasoline or diesel.
3. Engine emissions are generally high compared to external combustion engine.
4. Not suitable of large scale power generation.
5. In case of reciprocating internal combustion noise is generated due to detonation.

जल्दी बताओ Questions-1

GATEWAY CLASSES

Which type of engine typically operates with steam as the working fluid?

a) Internal Combustion Engine (ICE)

b) External Combustion Engine (ECE)

Classification of an I.C. Engine

1. On the basis of strokes used

- Two Stroke cycle Engines
- Four Stroke Cycle Engines

2. On the basis of cycle used

- Otto Cycle Engines
- Diesel Cycle Engines
- Dual Cycle Engines

3. On the basis of types of fuel used

- Petrol Engines
- Diesel Engines
- Gas Engines

4. On the basis of types of Ignition Method :

- Spark Ignition (SI)
- Compression Ignition (CI)

5. On the basis of types of cooling system used:

- Air cooled engines
- Water cooled engines

5. On the basis of number of cylinders used:

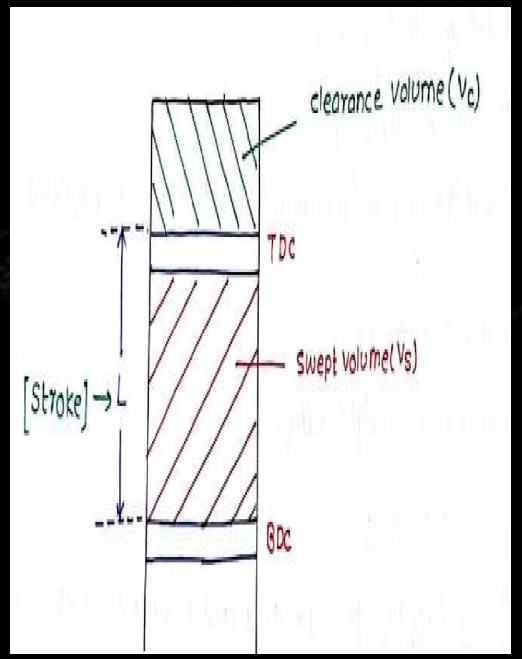
- Single cylinder engines
- Multi cylinders engines

GATEWAY CLASSES

6. Classify the IC engine on the basis of l/d ratio.

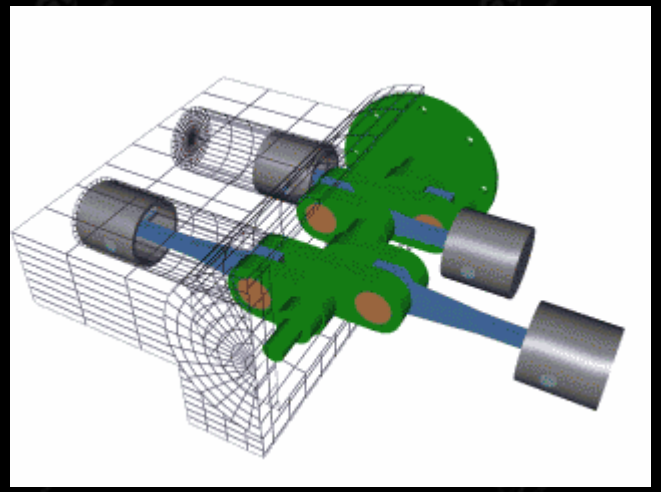
AKTU 2022-23

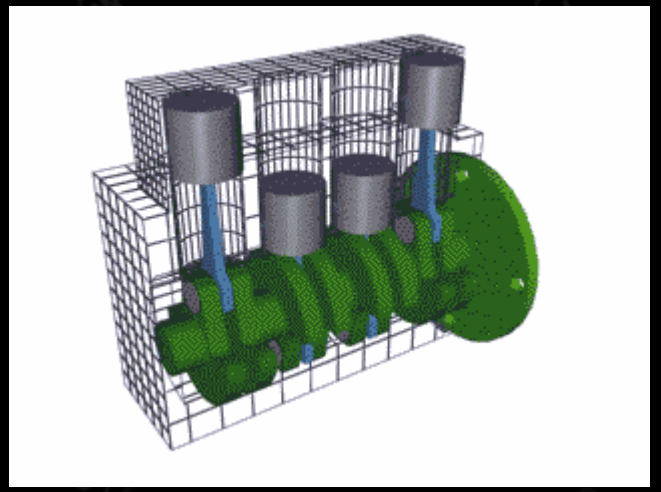
- **Long-stroke engines**
- These engines have a relatively long stroke compared to the bore diameter.
- Have an l/d ratio greater than 1.
- **Square engines**
- Square engines have an l/d ratio close to 1, which means the stroke length is roughly equal to the bore diameter.
- **Short-stroke engines**
- These engines have a shorter stroke compared to the bore diameter.
- Have an l/d ratio less than 1.

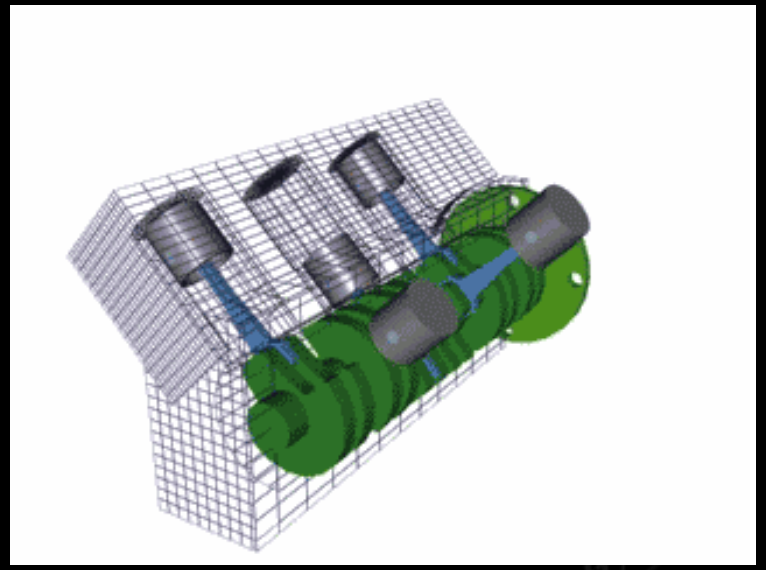


7. On the basis of types of different position of cylinder :

- **Horizontal cylinder engines**
- **Vertical cylinder engines**
- **Inclined cylinder engines**







GATEWAY CLASSES

जल्दी बताओ Questions-2

GATEWAY CLASSES

What defines the classification of an Internal Combustion (I.C.) Engine?

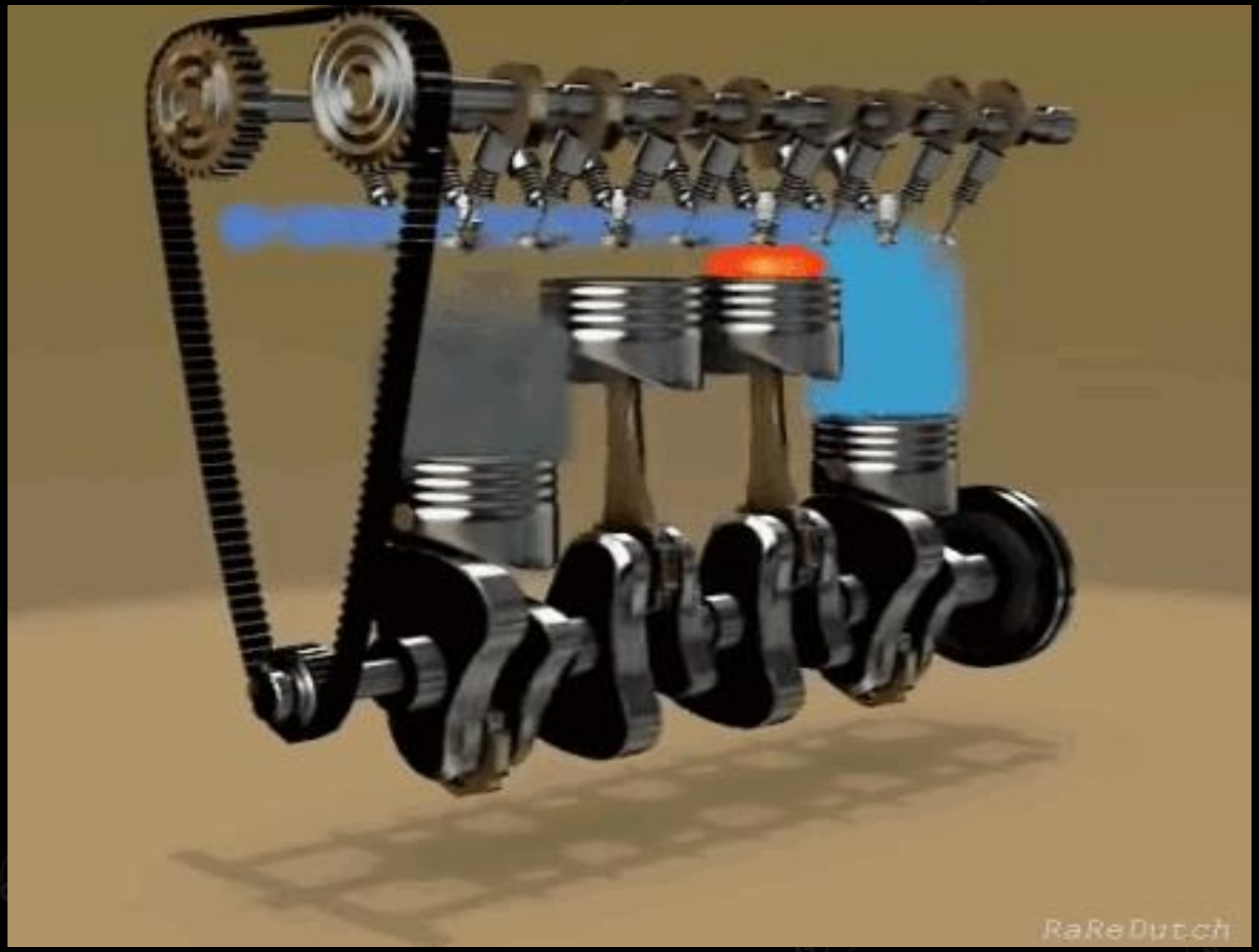
a) Type of fuel used

b) Method of cooling

c) Number of cylinders

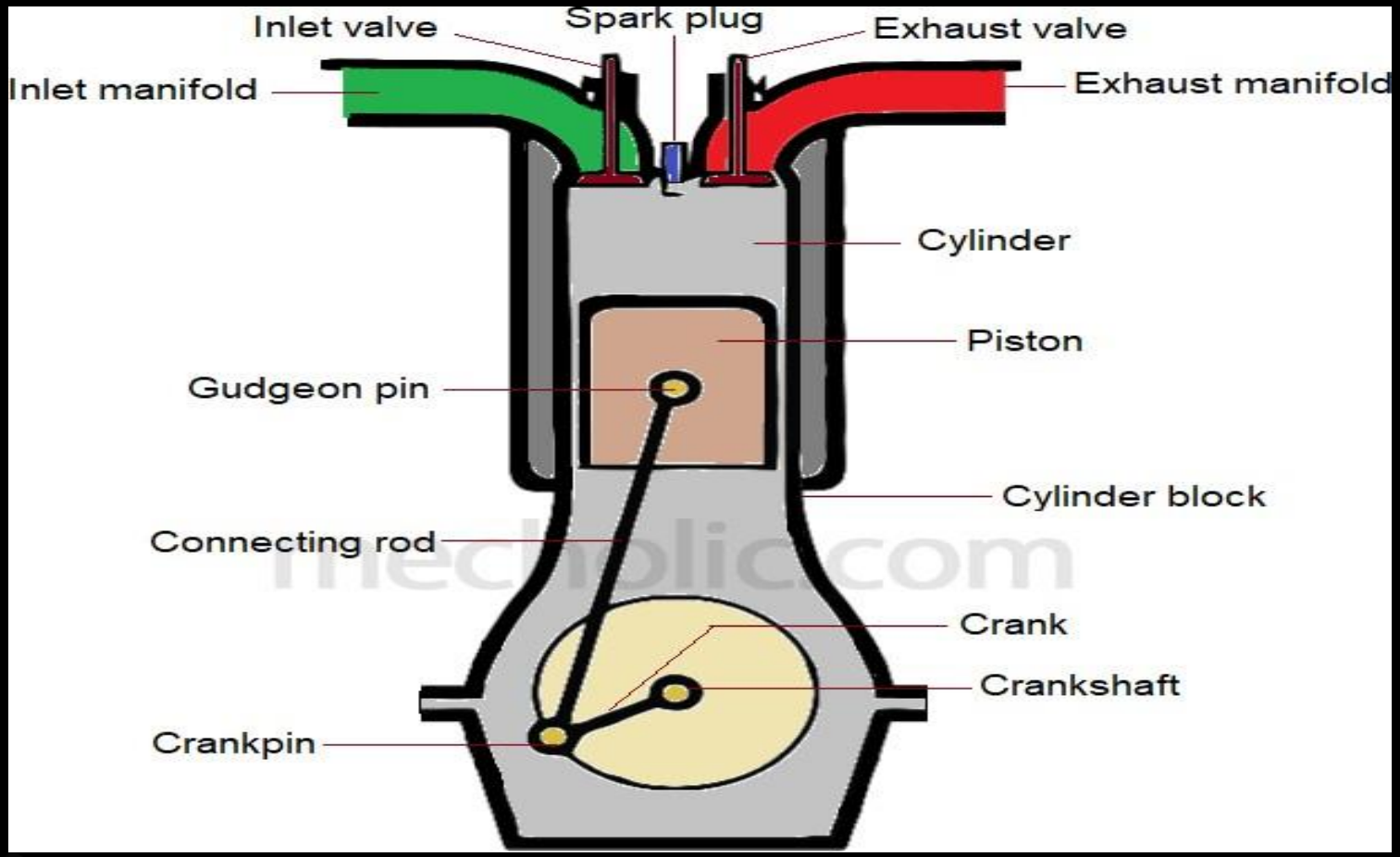
GATEWAY CLASSES

Main Components of an I.C.E.



GATEWAY CLASSES

Main Components of an I.C.E. [AKTU : 2021-22,23]



Cylinder Block: The foundation of the engine, housing the cylinders where the combustion process occurs. It is made of cast iron or aluminum.

Cylinders: These are cylindrical chambers where the combustion of fuel and air takes place. It is made of cast iron or aluminum.

Pistons: Pistons are cylindrical components that move up and down inside each cylinder. The pressure created by the combustion process forces the pistons down, converting the pressure into mechanical motion. It is made of aluminum alloy, sometimes with steel reinforcement.

Crankshaft: The crankshaft is a rotating shaft connected to the pistons through connecting rods. It converts the linear motion of the pistons into rotational motion, which is then used to drive the wheels of the vehicle. It is made of forged steel or nodular cast iron.

Camshaft(s): The camshaft controls the opening and closing of intake and exhaust valves. It is made of steel or cast iron .It is synchronized with the crankshaft and is responsible for timing the engine's valve operation.

GATEWAY CLASSES

Valves: **Valves are responsible for allowing the intake of air and fuel into the combustion chamber (intake valve) and expelling the exhaust gases (exhaust valve) after combustion. These are made of stainless steel .**

Combustion Chamber: The area inside the cylinder where the air and fuel mixture is ignited by a spark plug (in petrol engines) or by compression (in diesel engines).

Spark Plugs: In gasoline engines, spark plugs are used to ignite the air-fuel mixture in the combustion chamber, creating the controlled explosion that drives the piston down. It is made of Ceramic insulator with metal electrodes

Intake and Exhaust Manifolds: These are pathways that direct the intake air and fuel mixture into the cylinders and expel the exhaust gases out of the engine, respectively.

Fuel Injection/Carburetor System: The system responsible for mixing air and fuel in the right proportion before it enters the combustion chamber. Older engines use carburetors, while modern ones use fuel injection systems.

जल्दी बताओ Questions-3

Which is not a component of an I C Engine?

a) Flywheel

b) Piston

c) Furnace

d) None of the above

IC Engine Terminology [AKTU : 2021-22]

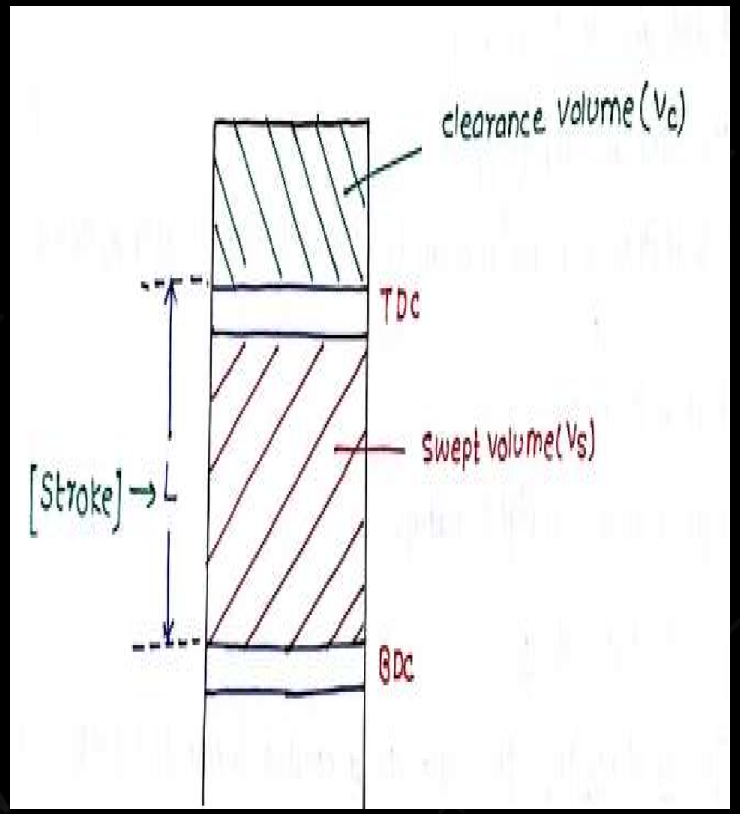
Top-Dead-Center (TDC): It is position of the piston when it is farthest from the crank shaft.

Bottom-Dead-Center (BDC): It is the position of the piston when it is nearest to the crankshaft.

Stroke: When piston moves from TDC to BDC or BDC to TDC is known as stoke.

Stroke Length (L): It is the distance between TDC and BDC.

Bore (D): Inner diameter of the cylinder or diameter of the piston face.



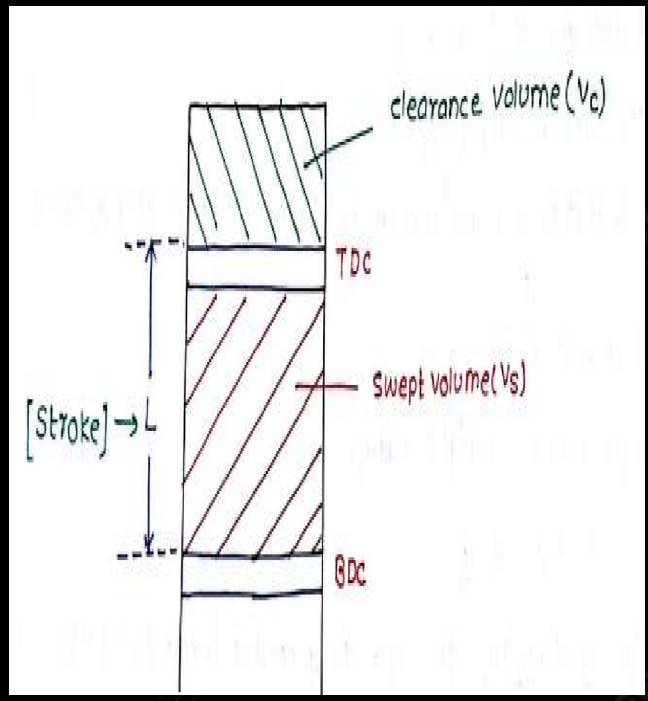
IC Engine Terminology [AKTU : 2021-22]

Swept Volume (V_S): Volume displaced by the piston as it travels through one stroke.

$$V_s = \frac{\pi}{4} D^2 L$$

Total swept $V_s = K \frac{\pi}{4} D^2 L$

Where K = no. of cylinders



Clearance Volume (V_C): It is the volume of the cylinder when piston is at TDC, therefore it is minimum volume.

Compression ration (r): It is defined as the ratio of volume before compression to the volume of after compression.

Volume before compression = $V_C + V_S$

Volume after compression = V_C

जल्दी बताओ Questions-4

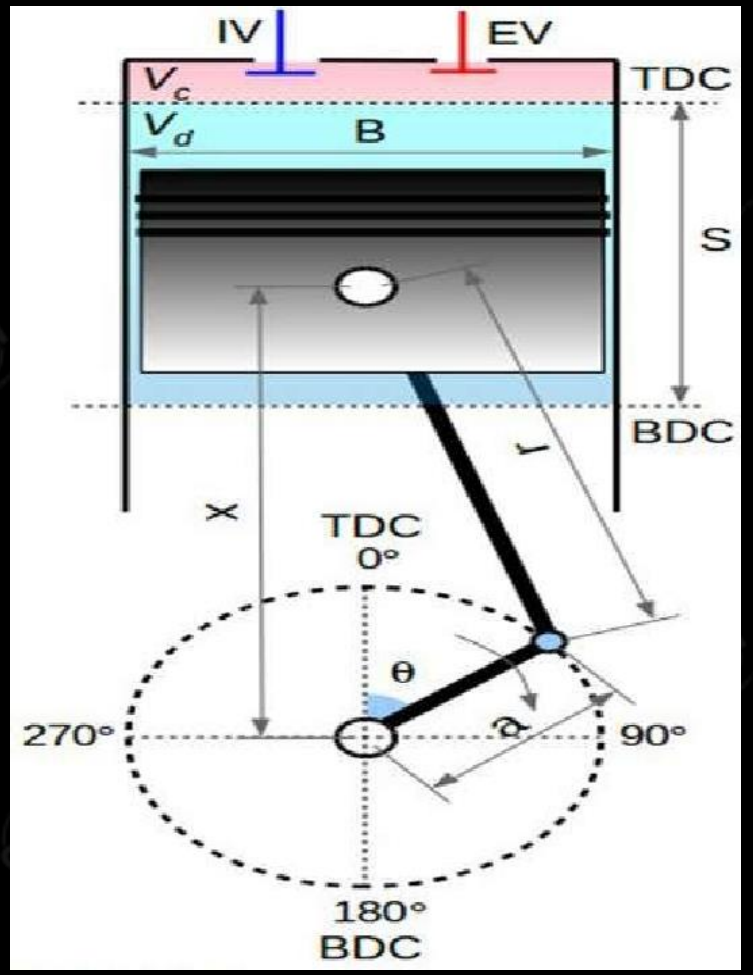
Which term describes the volume remaining in the combustion chamber when the piston is at TDC?

a) Compression Ratio

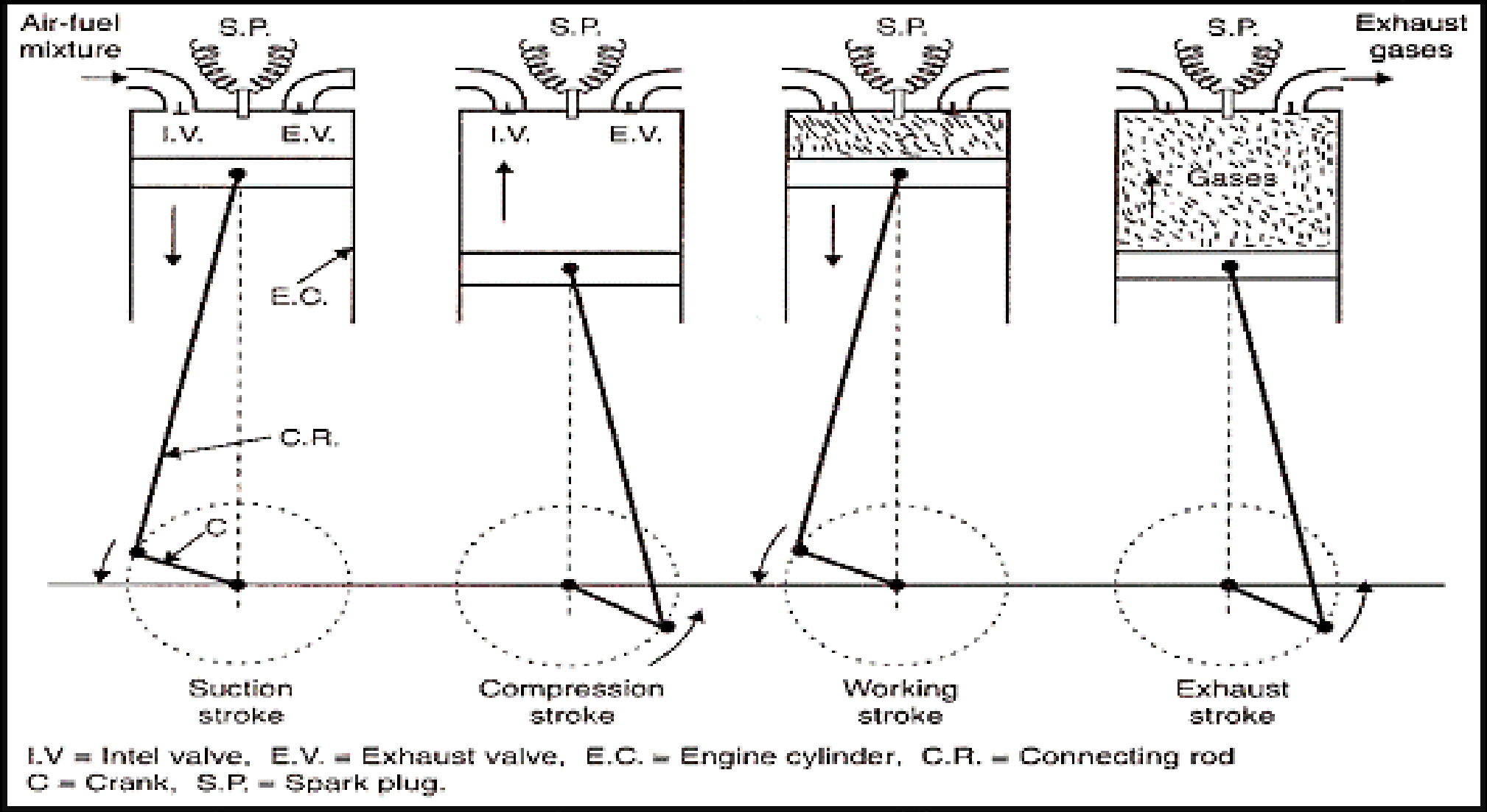
b) Clearance Volume

Four Stroke Engines

- If a Cycle of an engine is completed in **FOUR strokes of the piston** or **TWO revolution (720^{o})** of the crank is known as four stroke engine.
- Cycle consists of processes i.e. Intake, Compression, Expansion and Exhaust.
- **Four Stroke Engines may be SI or CI.**
- SI engines work on Otto cycle
- CI engines work on Diesel cycle



Working of Four Stroke SI Engines [AKTU : 2021-22]



I.V = Intel valve, E.V. = Exhaust valve, E.C. = Engine cylinder, C.R. = Connecting rod
C = Crank, S.P. = Spark plug.

Working of Four Stroke SI Engines [AKTU : 2021-22]

The working of a four-stroke spark-ignition (SI) engine involves four strokes:

1. Intake
2. Compression
3. Power
4. Exhaust.

These strokes are repeated in a continuous cycle to produce power

1.Intake Stroke (Suction)

- Piston moves downward from TDC to BDC.
- Inlet valve is opened and the exhaust valve is closed.
- Pressure inside the cylinder is reduced below the atmospheric pressure.
- The mixture of air fuel is sucked into the cylinder through the inlet valve.
- The timing of the intake valve is controlled by the camshaft, which is synchronized with the engine's rotation.

2. Compression Stroke:

- Compression Stroke:
- Piston moves up from BDC to TDC.
- Both inlet and exhaust valves are closed.
- Temperature and pressure increased due to compression of air
- fuel mixture in the cylinder.
- At the end of compression combustion starts with spark plug.

3. Power Stroke (Expansion):

- The burning gases expand rapidly.
- Gases exert an impulse (thrust or force) on the piston.
- The piston is pushed from TDC to BDC.
- This linear motion of the piston is converted into rotary motion of the crankshaft through connecting rod.
- Both inlet and exhaust valves are closed.

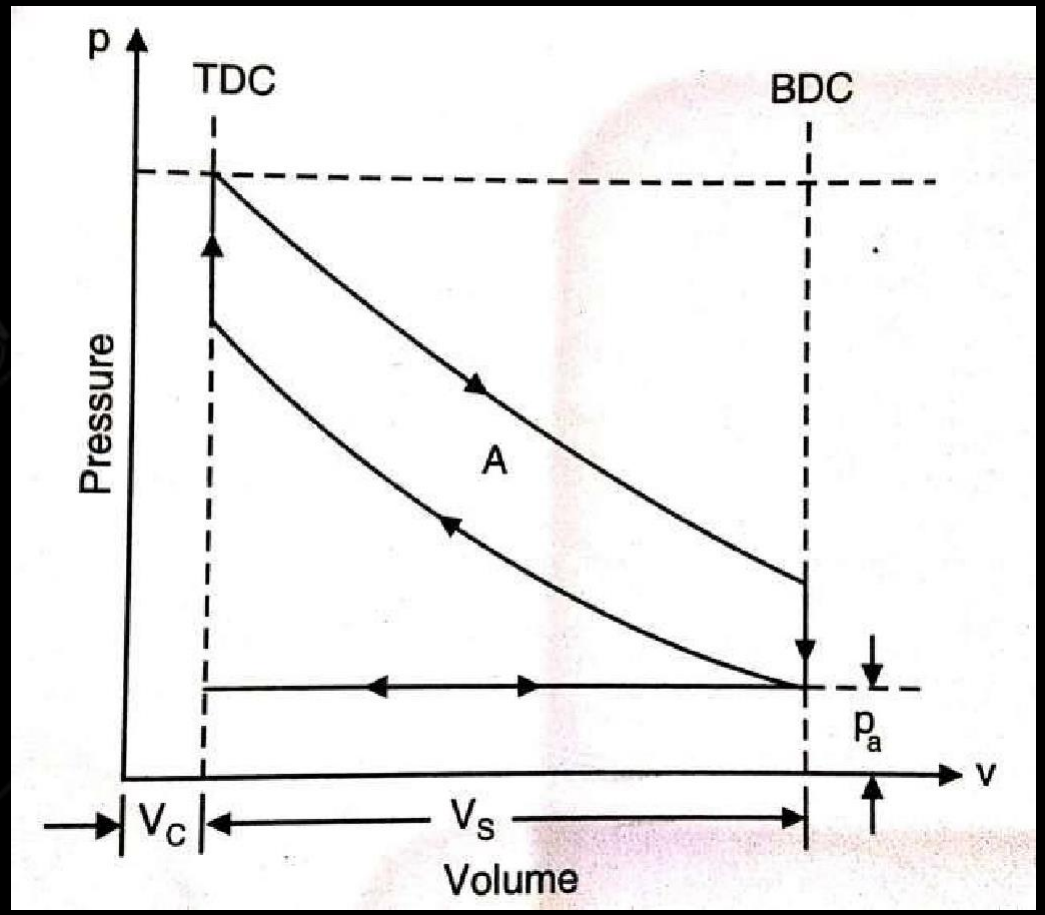
4. Exhaust Stroke:

- Piston moves upward from BDC to TDC.
- Exhaust valve is opened and the inlet valve is closed.
- The burnt gases are forced out to the atmosphere through the exhaust valve.
- The inlet valve opens slightly before TDC and the cylinder is ready to receive fresh charge to start a new cycle.

After the exhaust stroke, the cycle repeats, and the engine continues to operate as long as there is a supply of air-fuel mixture and a spark to ignite it.

GATEWAY CLASSES

P-V diagram for Otto Cycle : SI Engine



जल्दी बताओ Questions-5

GATEWAY CLASSES

What is responsible for igniting the air-fuel mixture in a four-stroke SI engine?

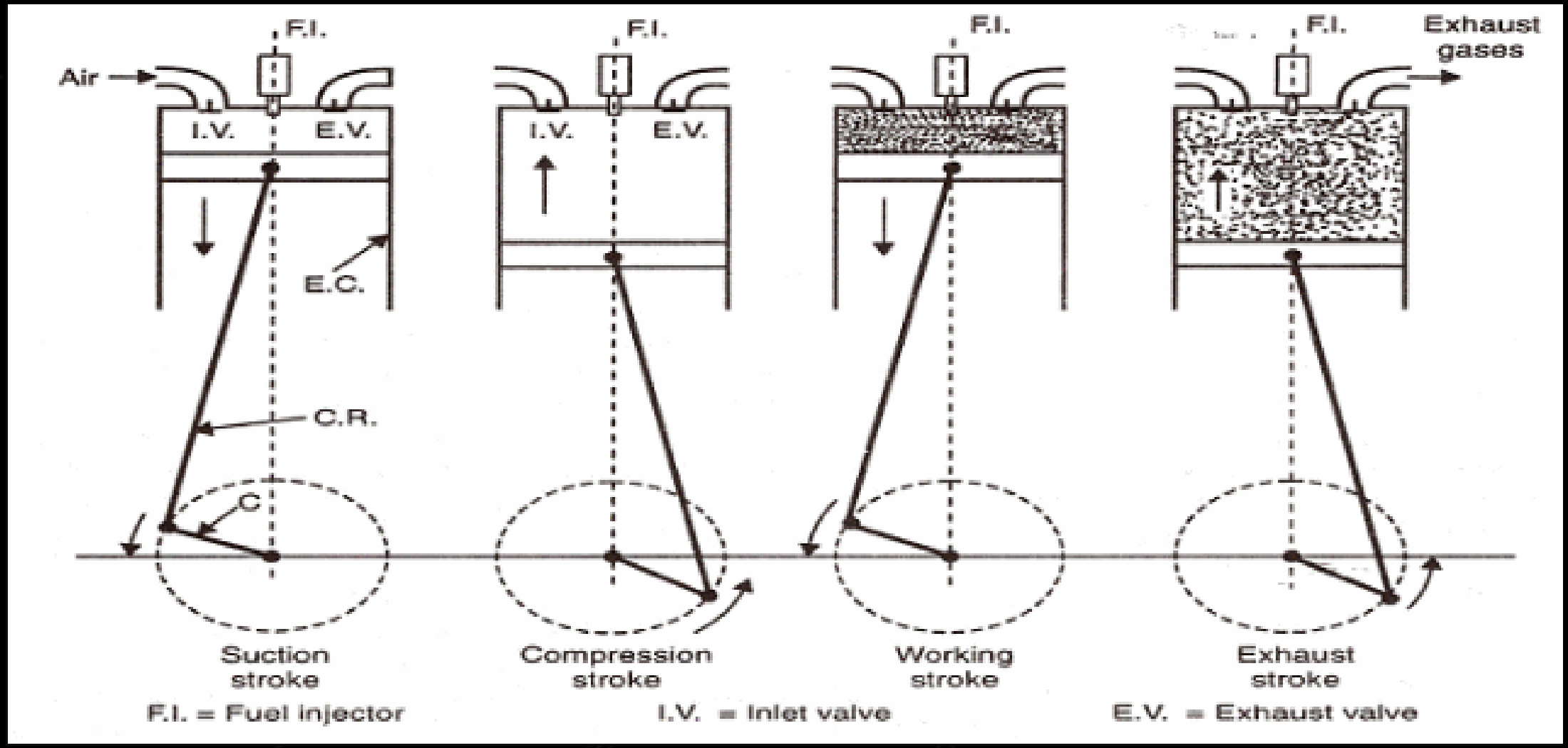
a) Carburetor

b) Fuel injector

c) Spark plug

d) Exhaust valve

Working of Four Stroke CI Engines [AKTU : 2020-21]



Working of Four Stroke CI Engines [AKTU : 2020-21]

The working of a four-stroke spark-ignition (SI) engine involves four strokes:

1. Intake
2. Compression
3. Power
4. Exhaust.

These strokes are repeated in a continuous cycle to produce power

1.Intake Stroke (Suction)

- Piston moves from TDC to BDC.
- Inlet valve is opened and the exhaust valve is closed.
- When piston moves from TDC to BDC ,the pressure inside the cylinder is reduced below the atmospheric pressure.
- Fresh air from the atmosphere is sucked into the engine cylinder through air cleaner and inlet valve.

2. Compression stroke:

- Piston moves from BDC to TDC.
- Both inlet and exhaust valves are closed.
- The only air is drawn during suction stroke is compressed to a high pressure and temperature.

3. Power Stroke (Expansion):

- Fuel (diesel) is injected inside the cylinder with the help of fuel injector.
- The burning gases expand rapidly and push the piston from TDC to BDC.
- This linear motion of piston is converted into rotary motion of the crank shaft through connecting rod.
- Both inlet and exhaust valves are closed.

GATEWAY CLASSES

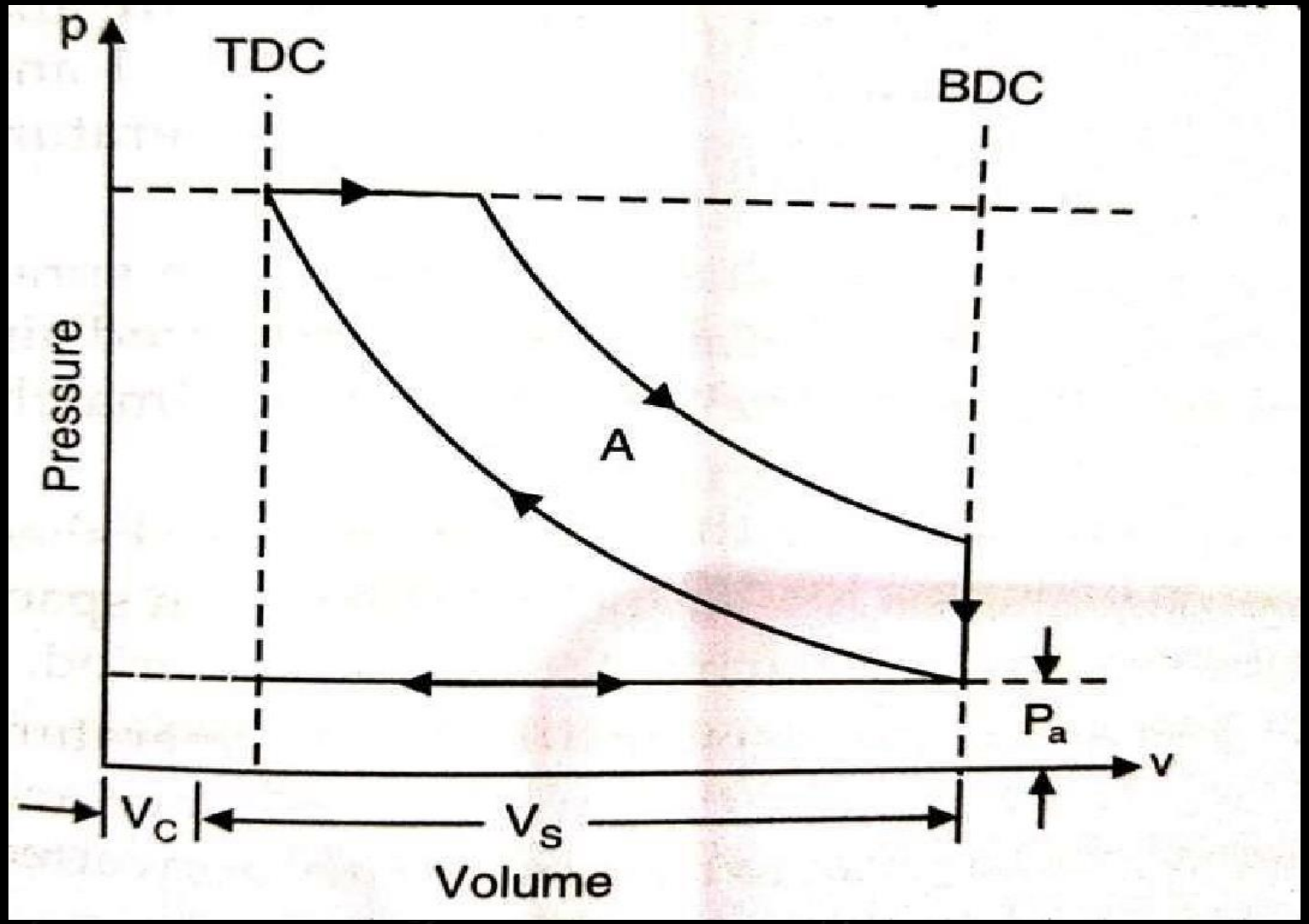
Exhaust Stroke:

- Piston moves from BDC to TDC.
- Exhaust valve is opened the inlet valve is closed.
- The burnt gases are forced out to the atmosphere through the exhaust valve.
- The inlet valve opens slightly before TDC and the cylinder is ready to receive fresh air to start a new cycle.

After the exhaust stroke, the cycle repeats, and the engine continues to operate as long as there is a supply of air-fuel mixture and a spark to ignite it.

GATEWAY CLASSES

P-V diagram for Diesel Cycle : CI Engine



जल्दी बताओ Questions-6

GATEWAY CLASSES

What is the purpose of the intake stroke in a four-stroke engine?

a) Compression of the air-fuel mixture

b) Exhaust of burned gases

c) Intake of air-fuel mixture into the cylinder

d) Intake of air into the cylinder

GATEWAY CLASSES

जल्दी बताओ Questions-7

GATEWAY CLASSES

How many degrees of rotation the crankshaft does in a complete engine cycle (4 strokes ICE) ?

A. 720^{O}

B. 540^{O}

C. 360^{O}

D. None of above

GATEWAY CLASSES

Which is the correct order of the engine strokes ?

A. 1. intake 2. exhaust 3. compression 4. power

B. 1. power 2. intake 3. compression 4. exhaust

C. 1. intake 2. compression 3. power 4. exhaust

Differences between SI and CI Engines [AKTU : 2021-22]

S. No.	SI Engine	CI Engine
1	It works on **OTTO Cycle** or constant volume heat addition.	It works on **DIESEL Cycle** or constant pressure heat addition.
2	During the intake or suction process, **air and fuel** are used.	During the intake or suction process, **only air** is used.
3	The fuel used **Petrol** which is highly volatile. Self Ignition temperature is high.	The fuel used **Diesel** which is low volatile. Self- ignition temperature is low.
4	The fuel is supplied by **Carburetor**.	The fuel is supplied by **Injector**.
5	The maintenance **cost is low**.	The maintenance **cost is high.**
6	It is used in Small Vehicles.	It is used in Heavy Vehicles.
7	The compression ratio is **6 to 10**.	The compression ratio is **16 to 22**.
8	The starting of this engine is **easy**.	Starting is a little difficult comparatively SI engine.
9	It produces **less noise**.	It produces **high noise**.
10	**Lower thermal efficiency** because of the low compression ratio.	**High** thermal efficiency because of the high compression ratio.

जल्दी बताओ Questions-8

GATEWAY CLASSES

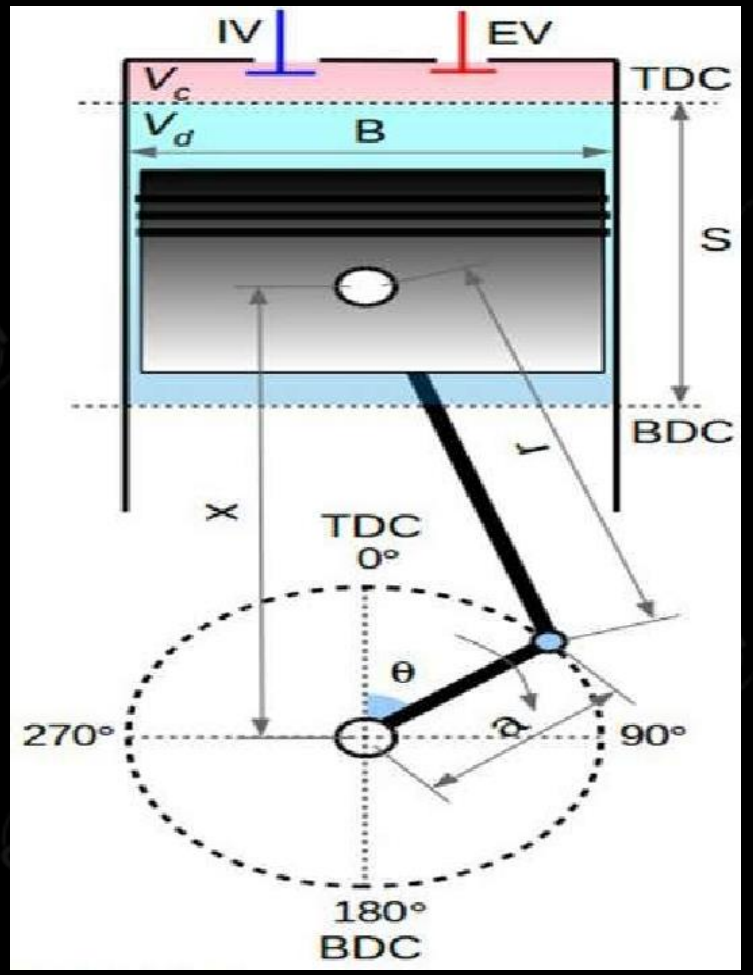
Which engine type typically operates at lower compression ratios?

a) SI engine

b) CI engine

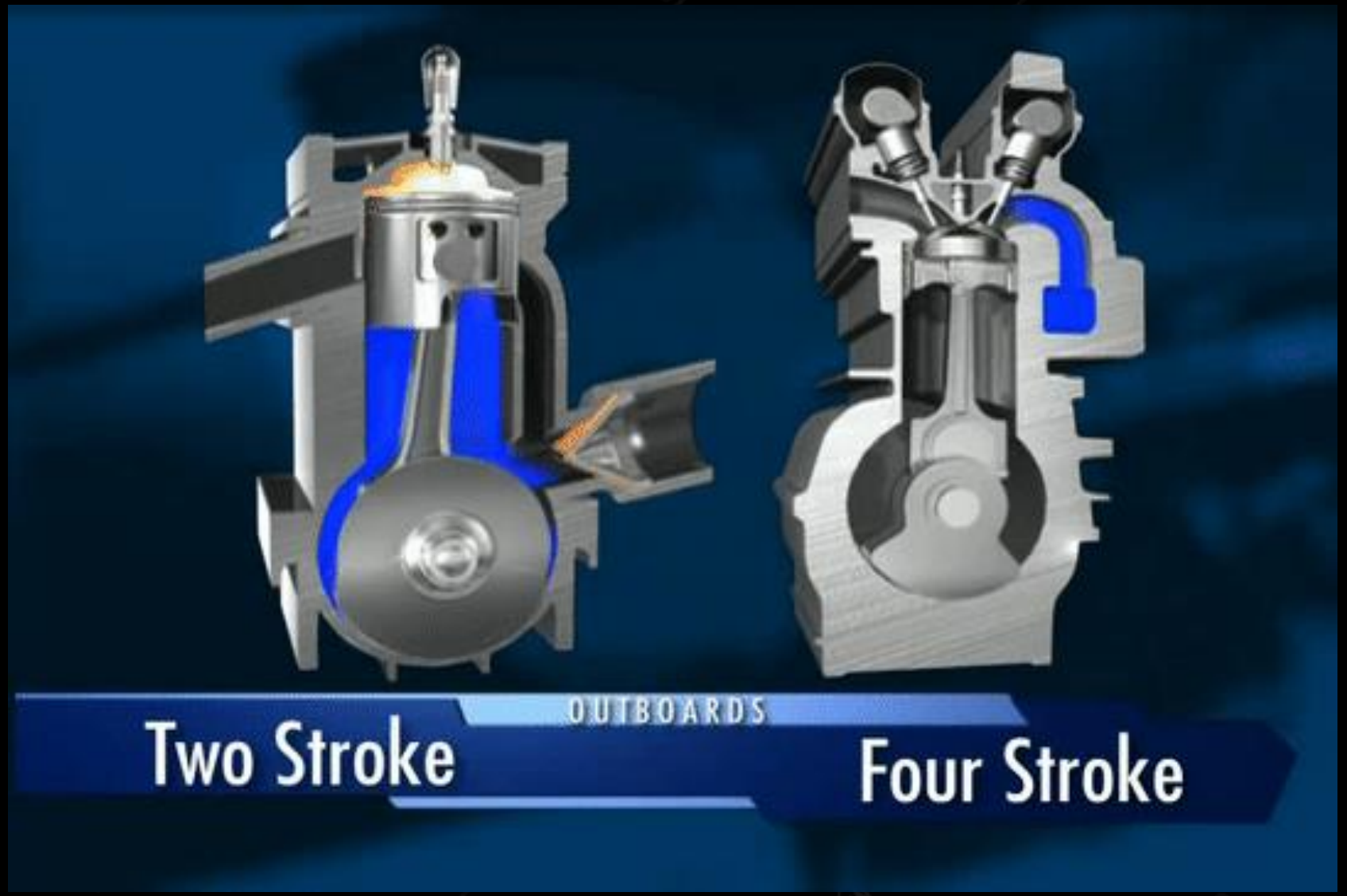
TWO Stroke Engines

- If a Cycle of an engine is completed in **TWO strokes of the piston** or **ONE revolution (360^{o})** of the crank is known as four stroke engine.
- Cycle consists of processes i.e. Intake, Compression, Expansion and Exhaust.
- **Four Stroke Engines may be SI or CI.**
- SI engines work on Otto cycle
- CI engines work on Diesel cycle



GATEWAY CLASSES

TWO Stroke Vs FOUR Engines

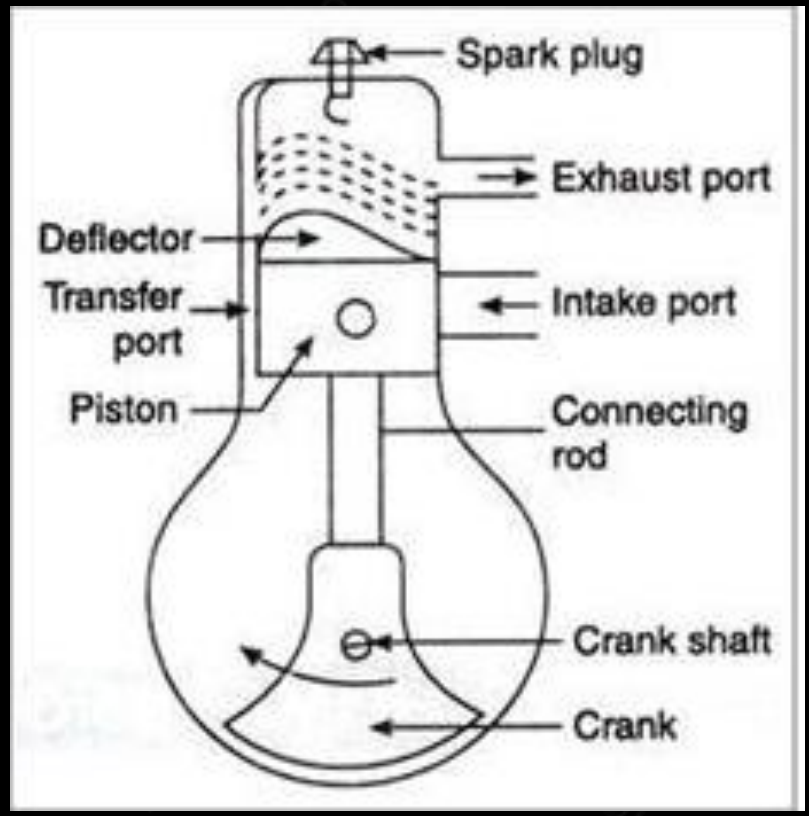


GATEWAY CLASSES

Working of Two Stroke SI Engines [AKTU : 2020-21]

Working

- The working of a two-stroke spark-ignition (SI) engine involves a simpler cycle compared to a four-stroke engine.
- It completes one power cycle in just two strokes of the piston.
- These engines are commonly used in small applications like motorcycles, scooters etc.



GATEWAY CLASSES

1.Intake and Compression:

- The piston moves from (BDC) to (TDC).
- Both transfer and exhaust ports are covered by the piston.
- Air fuel mixture which is already transferred into the cylinder is compressed by moving piston.
- The pressure and temperature increases at the end of compression.
- As piston almost reaches the top dead center. The air fuel mixture inside the cylinder is ignited by means of an electric spark produced by a spark plug.
- At the same time, the inlet port is uncovered by the piston. Fresh air fuel mixture enters the crankcase through the inlet port.

GATEWAY CLASSES

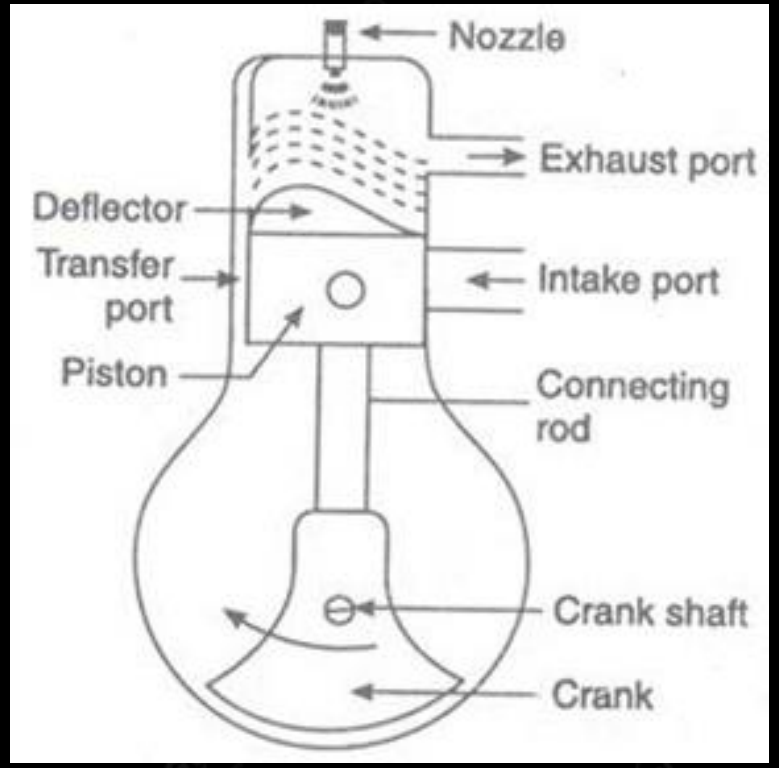
2. Power and Exhaust:

- The burning gases expand in the cylinder. The burning gases force the piston to move down. Thus useful work is obtained.
- When the piston moves down, the air fuel mixture in the crankcase is partially compressed.
- This compression is known as crank case compression.
- At the end of expansion, exhaust port is uncovered. Burnt gases escape to the atmosphere. Transfer port is also opened.

Working of Two Stroke CI Engines [AKTU : 2020-21]

Working

- The working of a two-stroke compression-ignition (CI) engine involves a simpler cycle compared to a four-stroke engine.
- It completes one power cycle in just two strokes of the piston.
- These engines are commonly used in small applications like motorcycles, scooters etc.



Working of Two Stroke CI Engines [AKTU : 2020-21]

GATEWAY CLASSES

1.Intake and Compression:

- The piston moves from (BDC) to (TDC).
- Both transfer and exhaust ports are covered by the piston.
- Air which is already transferred into the cylinder is compressed by moving piston.
- The pressure and temperature increases at the end of compression.
- Piston almost reaches the top dead center. The fuel is injected into the hot compressed air inside the cylinder.
- The fuel mixed with hot air and burns.
- The admission of fresh air into the crankcase continues till the
- piston reaches the top dead center.

GATEWAY CLASSES

2. Power and Exhaust:

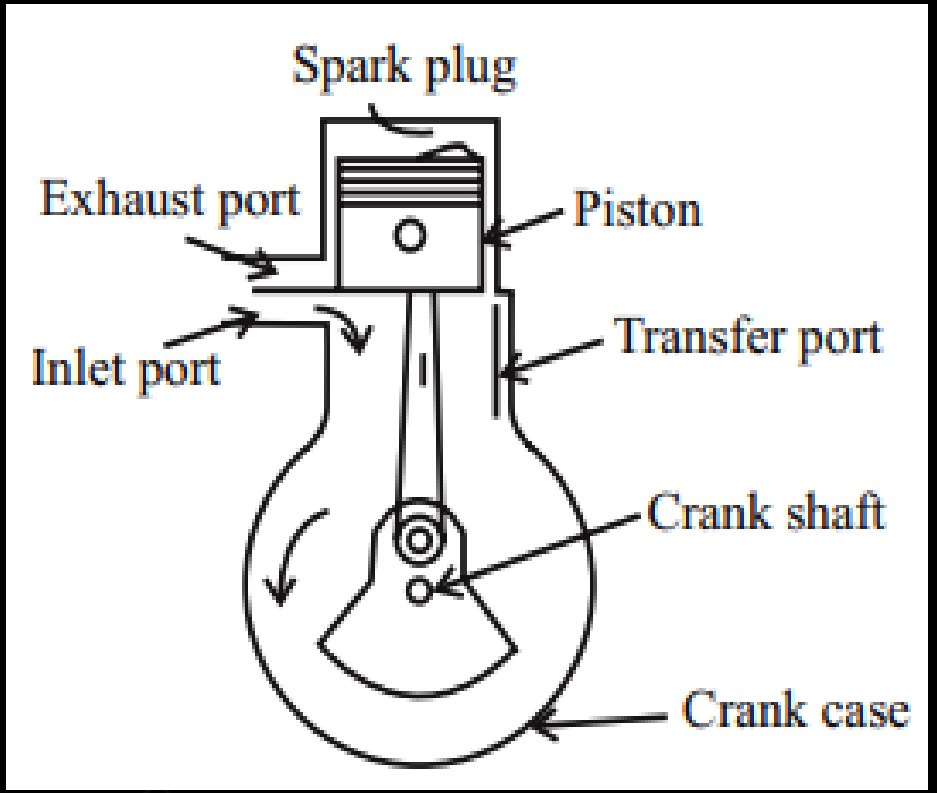
- The burning gases expand in the cylinder.
- Burning gases force the piston to move down. Thus useful work is obtained.
- At the same time, the air in the crank case is compressed partially by the movement of the piston from TDC to BDC.
- At the end of expansion, the exhaust port is uncovered.
- The burnt gases escape to the atmosphere through the exhaust port.

Scavenging Process [AKTU : 2020-21]

Scavenging:

- Scavenging is a process of pushing exhaust gases out of the cylinder.
- One of the critical aspects of two-stroke engine design is scavenging, which involves replacing the exhaust gases with fresh air-fuel mixture to optimize combustion efficiency.

- The charge (air fuel mixture or air) enters the engine cylinder from the crank case at a pressure higher than the exhaust gases.



Differences between 4 strokes and 2 strokes engines [AKTU : 2021-22]

S. No.	4-Stroke Engine	2-Stroke Engine
1	Four stroke of the piston and **two revolution** of crankshaft	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	Power produce is less	Theoretically twice power
4	**Heavier flywheel** due to non-uniform turning movement	**Lighter flywheel** due to more uniform turning movement
5	Lesser cooling and lubrication requirements	Greater cooling and lubrication requirements
6	**Contains valve** and valve mechanism	**Contains ports** arrangement
7	Volumetric efficiency and Thermal efficiency are **high** but mechanical efficiency is **low**.	Volumetric efficiency and Thermal efficiency are **low** but mechanical efficiency is **high**.
8	Heavy and bulky	Light and compact

जल्दी बताओ Questions-9

Which type of engine typically produces more power output for the same displacement?

a) Four-stroke

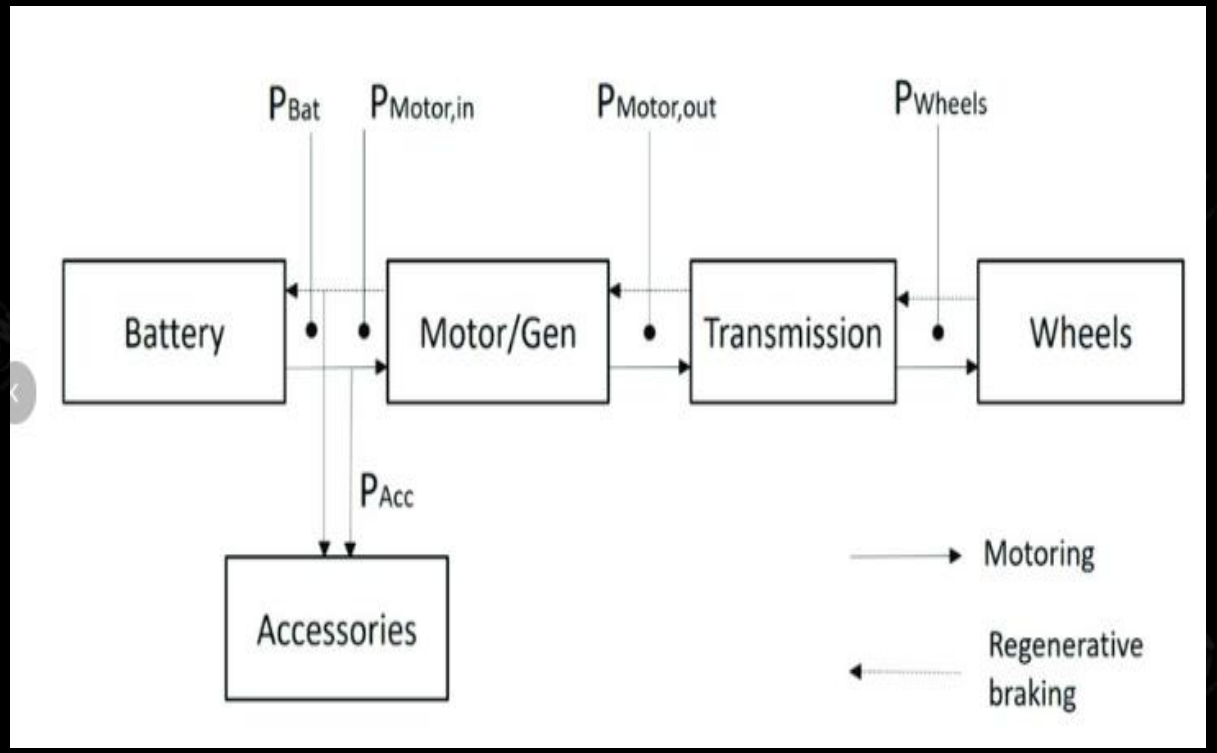
b) Two-stroke

Electric vehicle [AKTU-2021-22]

- An electric vehicle (EV) is a vehicle that uses one or more electric motor for propulsion.
- The electric motors are the replacement of ICE.

Main components of electric vehicle are

- Battery
- Electric motor
- Battery charger
- Power electric converter



Electric vehicles (EVs) have gained popularity in recent years due to their potential to reduce greenhouse gas emissions and dependence on fossil fuels.

Advantages and Dis-advantages of an Electric vehicle

Advantages:

- **Environmental Benefits:** EVs produce zero emissions, which helps reduce air pollution and greenhouse gas emissions, leading to improved air quality and a healthy environment.
- **Energy Efficiency:** Electric vehicles are more energy-efficient than internal combustion engine vehicles. They convert a higher percentage of energy from the electricity grid into usable power for driving, reducing energy waste.
- **Lower Operating Costs:** EVs have lower operating costs compared to traditional gas-powered vehicles. Electricity is generally cheaper than gasoline, and EVs require less maintenance due to less moving parts.

- **Reduced Noise Pollution:** Electric vehicles are quieter than internal combustion engine vehicles, reducing noise pollution in urban areas and creating a quieter driving experience.
- **Government Incentives:** Many governments offer incentives and subsidies to encourage the adoption of electric vehicles, such as tax credits, reduced registration fees etc.
- **Regenerative Braking:** EVs often have regenerative braking systems, which recapture energy during braking and store it in the battery, further improving energy efficiency.

Advantages and Dis-advantages of an Electric vehicle

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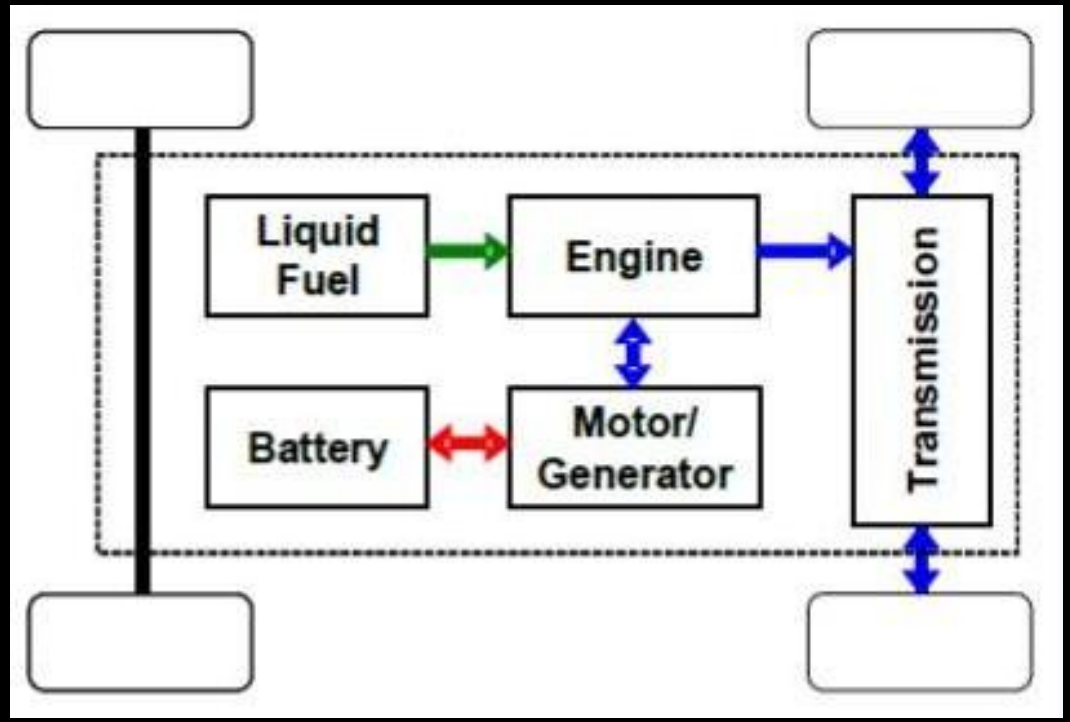
Disadvantages

- **Limited Driving Range:** One of the primary challenges with EVs is their limited driving range compared to conventional vehicles. Although ranges are improving, some EVs may still not be suitable for long-distance travel without frequent charging.
- **Charging Infrastructure:** The availability of charging stations can be limited in some areas, making it difficult for EV drivers to charge their vehicles conveniently, especially in remote regions.

- **Longer Refueling Time:** Charging an EV takes longer than refueling a conventional vehicle with gasoline. Even with fast-charging technology, it may still take several minutes to an hour to charge fully, depending on the battery capacity and charging speed.
- **Initial Cost:** Electric vehicles generally have a higher cost compared to traditional gasoline-powered cars, mainly due to the cost of batteries. However, prices have been decreasing as technology advances and production scales up.
- **Battery Life and Recycling:** Battery life and recycling are ongoing concerns for EVs. While battery technology is improving, eventually, all batteries will degrade and need replacement. Proper battery recycling and disposal are essential to minimize environmental impacts.

Hybrid Electric Vehicles (HEV)

- A hybrid vehicle is a type of automobile that combines two or more power sources to provide propulsion.
- The most common type of hybrid vehicle is the hybrid electric vehicle (HEV), which typically combines an internal combustion engine (ICE) and an electric motor.



Types of hybrid vehicles

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Parallel Hybrid Electric Vehicle (PHEV):

- In a parallel hybrid, both the internal combustion engine and the electric motor are connected to the vehicle's transmission, allowing either or both power sources to drive the wheels simultaneously.
- The electric motor assists the engine during acceleration and provides regenerative braking to recharge the battery when the vehicle slows down.

Series Hybrid Electric Vehicle (SHEV):

- In a series hybrid, the internal combustion engine does not directly drive the wheels.
- Instead, it serves as a generator to charge the battery, which then powers the electric motor that drives the wheels.
- The engine may come into direct operation in certain situations, such as when the battery charge is low or during high-power demands.

EV Batteries

- Electric vehicle (EV) batteries are a critical component of electric vehicles, providing the energy storage needed to power the electric motor and propel the vehicle.
- These batteries are typically rechargeable and store electrical energy in the form of chemical energy allowing the vehicle to travel without the need for an internal combustion engine.

Types of EV Batteries

1. Lithium-ion (Li-ion) Batteries
2. Solid-State Batteries:

1. Lithium-ion (Li-ion) Batteries:

- Lithium-ion batteries are the most common type used in electric vehicles due to their high energy density, which allows for longer driving ranges and better performance.
- They offer a good balance between energy capacity, weight, and cost. Many EV manufacturers use variations of lithium-ion chemistry, such as lithium iron phosphate (LiFePO4) and lithium nickel manganese cobalt oxide (NMC).

EV Batteries

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2. Solid-State Batteries:

- Solid-state batteries are an emerging technology that aims to replace the liquid electrolyte in traditional lithium-ion batteries with a solid-state electrolyte.
- These batteries have the potential to offer higher energy densities, faster charging times, and improved safety compared to conventional lithium-ion batteries. However, they are still in the early stages of commercialization and not yet widely used in EVs.

Electric vehicle (EV) Chargers

- Electric vehicle (EV) chargers are devices used to recharge the batteries of electric vehicles.
- There are different types of EV chargers, each with varying charging speeds and applications.

Types of EV chargers:

1.Level 1 Charger (120V):

- Level 1 chargers are the most basic and usually come with the electric vehicle when purchased. They operate on a standard 120-volt household outlet.
- These chargers are relatively slow and are suitable for overnight charging at home. Level 1 chargers typically provide a charging rate of about 3 to 5 miles of range per hour of charging.

2. Level 2 Charger (240V):

- Level 2 chargers are more powerful than Level 1 chargers and require a 240-volt outlet. They are commonly installed at homes, workplaces, and public charging stations.
- Level 2 chargers provide faster charging rates, typically adding around 10 to 30 miles of range per hour of charging, depending on the vehicle and charger specifications.

3. DC Fast Charger (Level 3 Charger):

- DC fast chargers, also known as Level 3 chargers, are high-powered chargers commonly found at public charging stations, rest areas, and along highways.
- They provide rapid charging by delivering direct current (DC) power to the vehicle's battery.
- DC fast chargers can recharge an EV to 80% capacity in around 30 minutes, making them ideal for long-distance travel and quick top-ups.

4.Tesla Supercharger

- Tesla Superchargers are exclusive to Tesla electric vehicles.
- They are high-speed DC fast chargers designed specifically for Tesla cars.
- Superchargers can provide fast charging rates and are strategically placed along highways and popular travel routes to support long-distance travel for Tesla owners.

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जल्दी बताओ Questions-10

What is the primary advantage of electric vehicles (EVs) over conventional vehicles with internal combustion engines?

a) Lower initial cost

b) Higher emissions

c) Lower operating costs

d) Limited range

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