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# **Systems in Mechanical Engineering – 102003**

F.E-Semester I

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Department of Mechanical Engineering  
SCOE, Vadgaon**

# **UNIT- III Vehicles and their Specifications (4 Hrs)**



# Syllabus

- Classification of automobile, Vehicle specifications of two/three wheeler, light motor vehicles, trucks, buses and multi-axle vehicles.
- Engine components (Introduction), Study of engine specifications, Comparison of specifications of vehicles.
- Introduction of Electric and Hybrid Vehicles. Cost analysis of the Vehicle.

# Classification of Automobile

## 1. Based on number of wheels :

- **Two wheeler** : Motorcycles, Scooters
- **Three-wheelers** : Tempo, Auto-rickshaws, tricycles
- **Four wheeler** : Car, Jeep, Bus, truck
- **Six wheeler**: large trucks, large busses

## 2. Based on Purpose :

- **Passenger vehicles**: These vehicles carry passengers.  
e. g: Buses, Cars, passenger trains.
- **Goods vehicles**: These vehicles carry goods from one place to another place.  
e. g: Trucks, Tempo.
- **Special Purpose**: These vehicles include Ambulance, Fire engines, Army Vehicles.

# Classification of Automobile

## 3. Based on fuel used:

- **Petrol engine vehicles** : Automobiles powered by a petrol engine.  
e. g: scooters, cars, motorcycles, mopeds.
- **Diesel engine vehicles** : Automobiles powered by diesel engine.  
e. g: Trucks, Buses, Tractors.
- **Electric vehicles** : Automobiles that use electricity as a power source.  
e. g: Electric cars, electric buses.
- **Hydrogen Vehicles**: honda, FCX clarity

## 4. Based on Load Capacity:

- **Light duty vehicle**: Small motor vehicles.  
e. g: Car, Jeep, Scooter, Motorcycle
- **Heavy duty vehicle**: large and bulky motor vehicles.  
e. g: Bus, Truck, Tractor

# Classification of Automobile

## 5. Based on Side of Drive of the vehicles:

- **Left-Hand drive** : Steering wheel fitted on the left-hand side.
- **Right-Hand drive** : Steering wheel fitted on the right-hand side.

## 6. Based on type of transmission:

- **Automatic transmission vehicles:** Automobiles that are capable of changing gear ratios automatically as they move.  
e. g: Automatic Transmission Cars.
- **Manual transmission vehicles:** Automobiles whose gear ratios have to be changed manually.
- **Semi-automatic transmission vehicles:** Vehicles that facilitate manual gear changing with a clutch pedal.

## 7. Based on wheels of Drive:

- **Front Wheel Drive** – Honda City
- **Rear Wheel Drive** – Toyota Innova



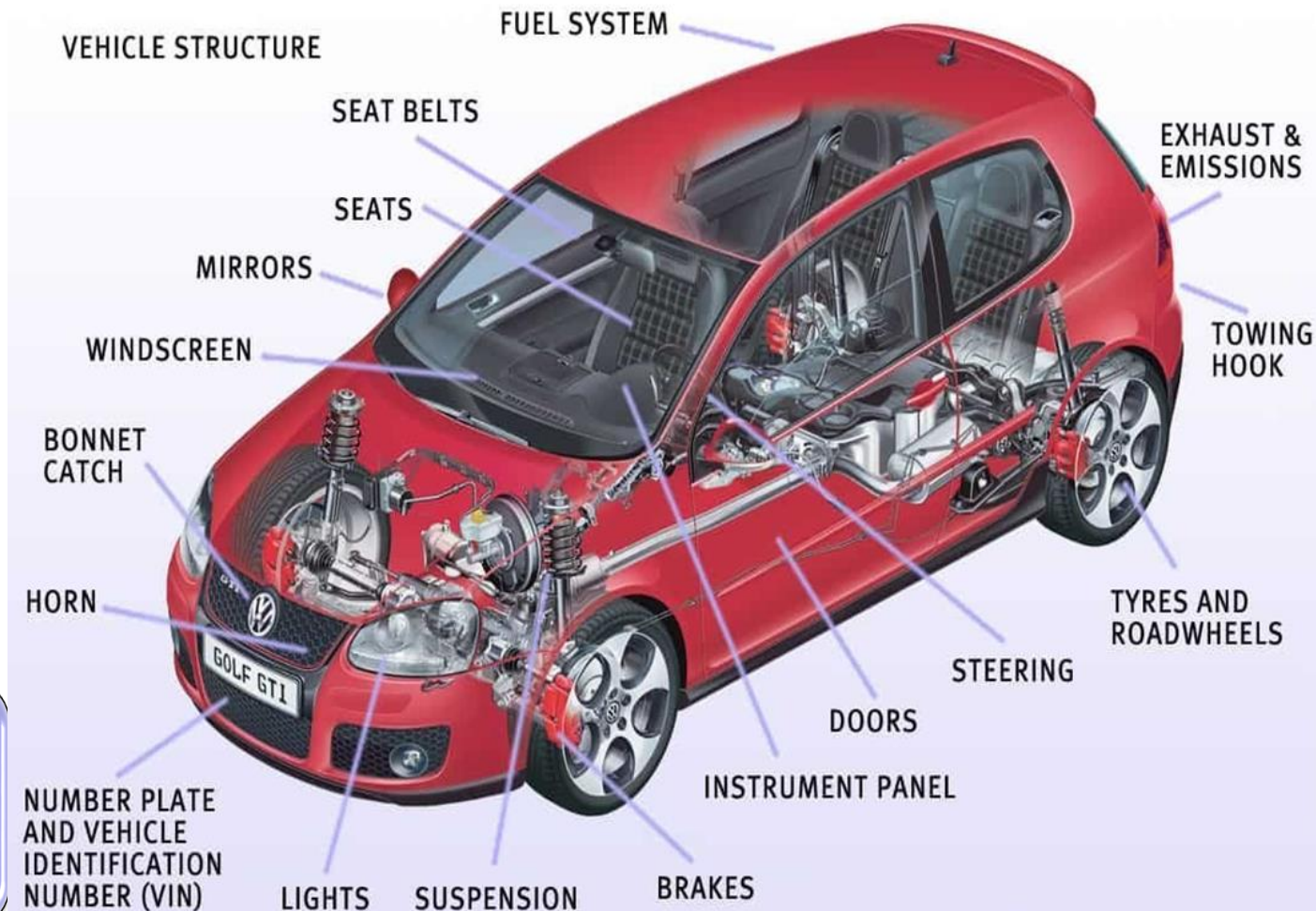
# Main Parts of the Automobile

What is  
Automobiles

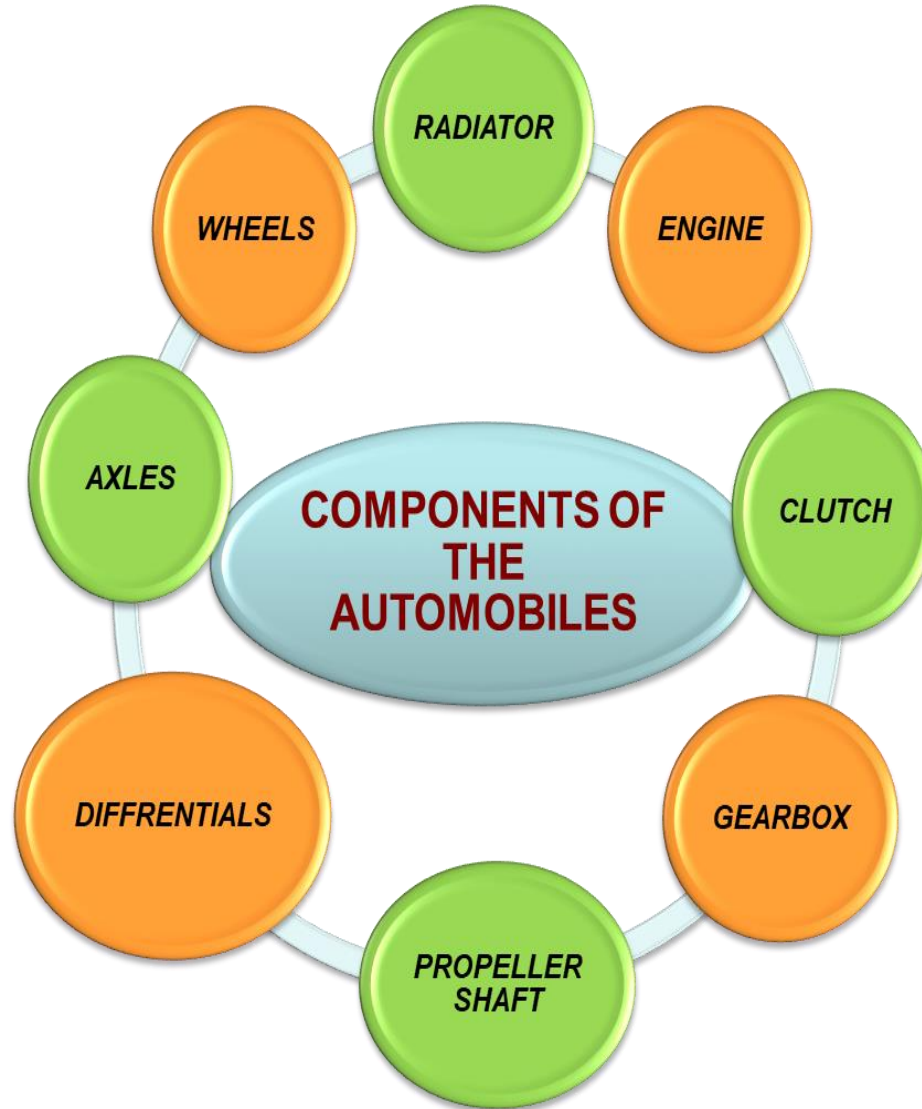
History Of  
Automobiles

Layout Of  
Automobiles

Function of  
Various  
Components







# Types of car body

## TYPES OF BODIES



hatchback

sports car



four-door sedan



limousine

convertible



hardtop



van



pick-up truck

# 1. Saloon(sedan)



- Saloon cars are three box/compartment cars.
- The front compartment consists of the engine.
- The passenger compartment is an enclosed compartment.
- The third compartment has space to accommodate luggage.
- Saloon cars generally have two doors on each side of the car.

## 2. Hatchback

- It is modification on the saloon car design.
- It consist of only two box/compartment without any dedicated luggage space.

**What is Hatchback?**



### 3.Limousine

- A limousine is also similar to a saloon car but has an extended passenger compartment.
- Within the passenger compartment the driving compartment is separated from the rear compartment by a sliding glass division.





## 4.Sports cars

- A sport car is a low height coupe car design.
- It has one door on each side and has aerodynamic body shape to offer least resistance to flowing air.



## 5.Van



- Vans are light transport carrier vehicles used for short distance transport.
- The engine is generally located over or just in front of the driver compartment.
- Sufficient space is provided to accommodate luggage.
- The side doors are generally of sliding type.



## 6.Truck

- A truck is used for medium to heavy goods carriage.
- A truck has all its axles attached to a single frame.
- A truck may have more than two axles depending on the load capacity.



## 7. Bus



- Bus is used for carrying large number of people.
- The bus has very limited space to accommodate luggage.
- It has two doors the one at rear to get in and one at front to move out of bus.
- The buses have two floors called double decker bus.

## 8.Coach/Travels(multi-axle vehicle)

- A multi-axle bus has more than two axles(3 ro 4).
- A coach is similar to a bus to transport passenger but long distance.
- The interiors of a coach are designed to provide comfort of passenger.
- For better visibility large panelled windows are provided.



## Types of Driving License with their full forms

- **MCWOG:-** motorcycle without gear.
- **MCWG:-** motorcycle with gear.
- **LMV-NT:-** light motor vehicle Non transport.
- **LMV-CAB:-** light motor for passenger.
- **LMV-TVA/GV:-** light motor vehicle for transport
- **3W-NT:-3** wheeler vehicle Non transport.
- **3W-TVA:-3** wheeler vehicle for transport.
- **HPV:-** heavy passenger vehicle.
- **HGV:-** heavy goods vehicle
- **TVA:-** transport heavy vehicle
- **PBUS:-** passenger bus for heavy vehicles

# Specification of Vehicles

1. Two wheeler specifications
2. Three wheeler specifications
3. Four wheeler Specifications

# Two wheeler specification

Yamaha	FZ/FZ-S/Fazer
<b>Dimensions</b>	
Length* Width *Height	1,973 mm × 770 mm × 1,090 mm/1973mm x 770mm x 1045mm/1,973mm × 761mm × 1,119mm
Wheelbase	1,334mm
Ground Clearance	160 mm
Fuel Tank Capacity	12 liters
Kerb Weight	135 Kgs/141 Kgs
<b>Engine/Transmission</b>	
Type	Air cooled, 4 - stroke single cylinder
Displacement	153 cc
Max. Power	14PS / 7500 rpm
Max. Torque	13.6 Nm @ 6000 rpm
Bore x Stroke	58.0 × 57.9 mm
Clutch & Gear box	Multi-plate wet Clutch & 5 Speed constant mesh gear box
Fuel Supply System	Carburetor
<b>Breaks &amp; Tyres</b>	
Front & Rear Brake	Hydraulic Single Disc/Drum
Front & Rear Tyres	100/80-17 / 140/60-R17
<b>Electricals</b>	
Battery	12 V, 5.0 Ah
Head Light	12V – 35W / 35W – Halogen bulb
HOSTED ON : <b>Team-BHP.com</b> copyrights reserved owners	Self-start & Kick start



Model Name	RX4	RX3	TT250
Photo			
Supplier	ZONGSHEN	ZONGSHEN	ZONGSHEN
Engine/Motor	NC450	NC250	CG250
Displacement (cc)	450.3cc	250cc	229.5
Bore & Stroke (mm)	94.5*64	77x53.6	67X65
Compression Ratio	10.7:1	11.5:1	8.7:1
Starter	electric	electric	electric/kick
Fuel System	EFI	EFI	carb
Ignition	ECU	ECU	CDI
Max. Power (Kw/rp/m)	32KW or 43.5HP@8500	24.8HP	16.1HP@7000RPM
Max. Torque (N.m/rp/m)	40/7000	16.6	13.5ft. lbs@5,500RPM
Maximum Speed (MPH)	97.5	84	70
Transmission	6-speed	6-speed	5-speed
L x W x H (IN)	83.85 x 34.17 x 49.60	83.8 x 34.2 x 49.6	83 x 32 x 44
Wheelbase (IN)	56	55.1	55
Seat Height (IN)	31.89	31.3	34
Mini Ground Clearance (IN)	8.27	8.3	11.5
Fuel Capacity(GAL)	5.283	4.2	2.9
Curb weight(LB)	450	385	309
Fuel consumption (MPG)	65.34		
Brake	front disc/rear disc	front disc/rear disc	front disc/rear disc
Tire Size	front:110/80-19; rear:150/70-17	front:100-90-19; rear:130-70-17	front 300X21; rear 460X18



  <b>Specifications</b>					
Engine	313cc Single-cyl	373.2cc Single-cyl	295cc Single-Cyl	321cc Twin-cyl	296cc Twin-cyl
Power (PS)	35 @ 9500 RPM	43.5 @ 9000 RPM	28 @ 8000 RPM	42 @ 10,750 RPM	39 @ 11,000 RPM
Torque (Nm)	28 @ 7500 RPM	35 @ 7000 RPM	30 @ 5500 RPM	29.6 @ 9000 RPM	27 @ 10,000 RPM
Transmission	6-speed	6-speed	6-speed	6-speed	6-speed
Dimensions in mm (LxWxH)	1988 x 896 x 1227	1978 x 748 x 1098	2100 x 800 x 1165.5	2090 x 720 x 1135	2015 x 715 x 1100
Wheelbase (mm)	1374	1340	1465	1380	1405
Ground Clearance	NA	157 mm	173.5 mm	160 mm	125 mm
Seat Height	785 mm	800 mm	814.5 mm	780 mm	785 mm
Kerb Weight	158.5 kgs	154 kgs	183 kgs	169 kgs	172 kgs
Fuel Tank Capacity	11-litres	9.5-litres	21-litres	14-litres	17-litres
Instrument Cluster	Digital	Digital	Analog-Digital	Analog-Digital	Analog-Digital
Headlight	Single Lens	Dual Lens	Dual Lens	Dual Lens	Dual Lens
Tail Light	LED	LED	LED	LED	LED
Suspension Front	Up Side Down	Up Side Down	Up Side Down	Telescopic	Telescopic
Suspension Rear	Monoshock	Monoshock	Monoshock	Swingarm	Bottom-Link Uni-Trak
Brakes Front & Rear	300 mm (Front), 240 mm (Rear)	300 mm (Front), 230 mm (Rear)	320 mm (Front), 240 mm (Rear)	298 mm (Front), 220 mm (Rear)	290 mm (Front), 220 mm (Rear)
ABS	Yes	Yes	No	No	No
Tyres Front & Rear	110/70/R17 (Front), 150/60/R17 (Rear)	110/70/R17 (Front), 150/60/R17 (Rear)	110/70/R17 (Front), 150/60/R17 (Rear)	110/70/R17 (Front), 140/70/R17 (Rear)	110/70/R17 (Front), 140/70/R17 (Rear)
Price	Rs. 2.40 lakhs (est.)	Rs. 2.07 lakhs	Rs. 1.96 lakhs	Rs. 3.95 lakhs	Rs. 4.15 lakhs

\*All prices on-road, Mumbai

# Three Wheeler specification (Bajaj RE)

## TECHNICAL SPECIFICATIONS



### COMPACT

**PETROL · LPG · CNG · DIESEL**

Power	7.6 KW at 5000 rpm
Torque	17Nm at 3500 rpm
Cubic Capacity	198.88 cc
Transmission	4 forward + 1 reverse gear
Clutch	Wet multidisc type
Engine Type	4 Stroke
Kerb weight	348 Kg
Wheel Base	2000 mm
Overall width	1300 mm
Overall length	2635 mm
Overall Height	1700 mm
Gradeability	19%

# Bajaj RE compact PETROL auto rikshaw specifications

power	6.6kw@5000mm
torque	15.5 N.m @3300rpm
Cubic capacity	145.45cc
transmission	4 forward+1reverse
clutch	Wet multidisc type
Kerb weight	307kg
Wheel base	2000mm
Overall width	1300mm
Overall length	2635mm
Overall height	1692mm
Grade ability	18%
A car's grade ability is its ability to climb slopes. Grade ability is measured either in degrees or	A 45 degrees gradient is equivalent to 100 per cent. Grade ability is dependent on engine

# Bajaj RE Compact CNG/LPG auto Rikshaw Specification

power	5.3kw @5200rpm/6kw @5200rpm
torque	12.9 N.m @3500rpm/14.10 <a href="#">N.m@3500rp</a>
cubic capacity	145.45cc
transmission	4 forward+1reverse gear
clutch	Wet multidisc type
Kerb weight	368kg/344kg
Wheel base	2000mm
Overall width	1300mm
Overall length	2635mm
Overall height	1692mm
Grade ability	14% /16%



# Four wheeler specification

AUTO ADVICE.IN

## Mahindra Marazzo

Ask@Autoadvice.in



TYRE -215/60 R17 Tubeless

**1497 CC**

Diesel Engine

**121 BHP**

⚡ Power

**6-Speed**

Gearbox

**300 NM**

⚙️ Torque

**17.3 kmpl**

🛢️ Mileage

**45 Liter**

Fuel tank

**2760 MM**

Wheelbase

**160 MM**

Ground Clearance

**4585 MM**

Length

**1650 Kg**

Weight

**1774 MM**

Height

**1866 MM**

Width

### Engine ⚙️

1.5 Liter Turbo Diesel Engine  
121 BHP 3500 RPM of Power  
and 300 NM of Torque  
6-Speed Gearbox

### Brakes ⚙️

Front Brakes : Disc  
Rear Brakes : Disc  
ABS + EBD  
TWIN AIRBAG

### Suspension ⚙️

suspension Front : Double  
Wishbone  
Suspension Rear : Rear Twist  
Beam

### Price ₹

M2 - Rs. 9.99 lakh  
M4 -Rs. 10.95 lakh  
M6 - Rs. 12.40 lakh  
M8 -Rs. 13.90 lakh

\*Some Specifications / Price may vary after the final product launch

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**TOYOTA ALPHARD****TOYOTA ESTIMA****NISSAN ELGRAND****Description**

Model	<b>3.5 EXECUTIVE LOUNGE</b>	<b>G</b>	<b>VIP POWER SEAT PACKAGE</b>
Chassis ID	DBA-GGH30W	DBA-GSR55W	DBA-PE52
Base price in Yen (¥)	6,522,218	4,034,291	7,507,500
Release date	2015.1~	2015.5~	2012.12~
Body dimensions (L x W x H mm)	4915 x 1850 x 1935	4795 x 1800 x 1760	4915 x 1850 x 1815
Passenger compartment (L x W x H mm)	3210 x 1590 x 1400	3010 x 1580 x 1255	3020 x 1580 x 1270
Wheelbase (mm)	3000	2950	3000
Track front / rear wheels (mm)	1600/1605	1545/1550	1600/1600
Weight (kg)	2100	1900	2080
Body type	MV 1Box	MV 1Box	MV 1Box
Number of seats / doors	7 / 5 door	7 / 5 door	4 / 5 door

**Engine**

Series	2GR-FE	2GR-FE	VQ35DE
Type	V-type 6 cylinder DOHC	V-type 6 cylinder DOHC	V-type 6 cylinder DOHC
Bore x stroke length (mm)	94.0x83.0	94.0x83.0	95.5x81.4
Engine size	3456cc	3456cc	3498cc
Compression ratio	10.8	10.8	10.3
Fuel injection system	EFI	EFI	ニッサンEGI(ECCS)電子制御燃料噴射装置
Maximum power	280ps(206kW)/6200rpm	280ps(206kW)/6200rpm	280ps(206kW)/6400rpm
Maximum torque	35.1kg m(344N m)/4700rpm	35.1kg m(344N m)/4700rpm	35.1kg m(344N m)/4400rpm
Aspiration	—	—	—
Fuel tank capacity (L)	75 l	65 l	73 l
Fuel type	Unleaded premium gasoline	Unleaded premium gasoline	Unleaded premium gasoline
Fuel consumption (L / 100 km)	---	---	---

**Steering and suspension**



<b>Tata Indica eV2</b>	<b>V2 ( L / LE / LS )</b>	<b>EV2 ( L / LE / LS / LX )</b>	<b>EV2 Xeta ( GL / GLE / GLS / GLX )</b>
	<b>IDI BS3</b>	<b>Diesel CR4</b>	<b>MPFi</b>
<b>DIMENSIONS</b>			
Length x Width x Height	3690 mm x 1665 mm x 1485 mm		
Wheelbase	2400 mm		
Track : Front / Rear	1380 mm / 1360 mm		
Kerb Weight	995 kgs	1080 kgs	980 kgs
Ground Clearance	165 mm		
Turning Radius	4.9 m		
Seating Capacity	5		
Boot Capacity	220 litres		
Fuel Tank Capacity	37 litres		
<b>ENGINE</b>			
Type	IDI SOHC Diesel	DiCOR DOHC Diesel	MPFi SOHC Petrol
Displacement	1405 cc	1396 cc	1192 cc
Cylinders	4	4	4
Valvetrain	4 Valves / Cylinder	4 Valves / Cylinder	2 Valves / Cylinder
Bore & Stroke	75 x 79.6 mm	75 x 79 mm	75 x 67.5 mm
Max Power	52.77 Bhp @ 5500 rpm	69.04 Bhp @ 4000 rpm	64.41 Bhp @ 5000 rpm
Max Torque	85 Nm @ 2500 rpm	140 Nm @ 1800 - 3000 rpm	99.8 Nm @ 2700 rpm
Power / Weight Ratio	53.03 Bhp / ton	63.92 Bhp / ton	65.70 Bhp / ton
Torque / Weight Ratio	85.42 Nm / ton	129.62 Nm / ton	101.82 Nm / ton
BHP / Liter	37.69	49.31	53.67
Drivetrain	FWD		
Transmission	5-Speed Manual		
Service Intervals			
<b>SUSPENSION</b>			
Steering Type	Rack and Pinion		
Front suspension	Front Independent, Wishbone Type w/ McPherson Strut, Antiroll Bar		
Rear suspension	Independent, Semi Trailing Arm w/ Coil Spring Mounted on Hydraulic Shock Absorbers		
Tyre size	165 / 65 R13	165 / 65 R14	155 / 80 R13
Brakes : Front / Rear	Disc / Drum		
<b>FUEL EFFICIENCY</b>			
City	13.2 kpl	13.8 kpl	11.1 kpl
Highway	17.7 kpl	18.3 kpl	15.3 kpl
ARAI Rating	17.88 kpl	25 kpl	16.84 kpl



# Heavy vehicles

## Gradeability Comparison 6x4 Tipper (230 HP) – 1<sup>st</sup> & Crawler Gear

Gradeability Comparison	BB 2523	TATA Prima Lx 2523.K	TATA LPK 2523
Parameter	1st Gear	1st Gear	1st Gear
Eng Torque	810	900	835
Gear Ratio	9.48	9.139	9.139
Rear axle ratio	4.78	5.58	5.58
Drive line eff	0.95	0.95	0.95
	34,869	43,601	40,452
	65,544	72,912	76,038
Legal GVW	25000	25000	25000
<b>Grade ability</b>	<b>26%</b>	<b>29%</b>	<b>30%</b>

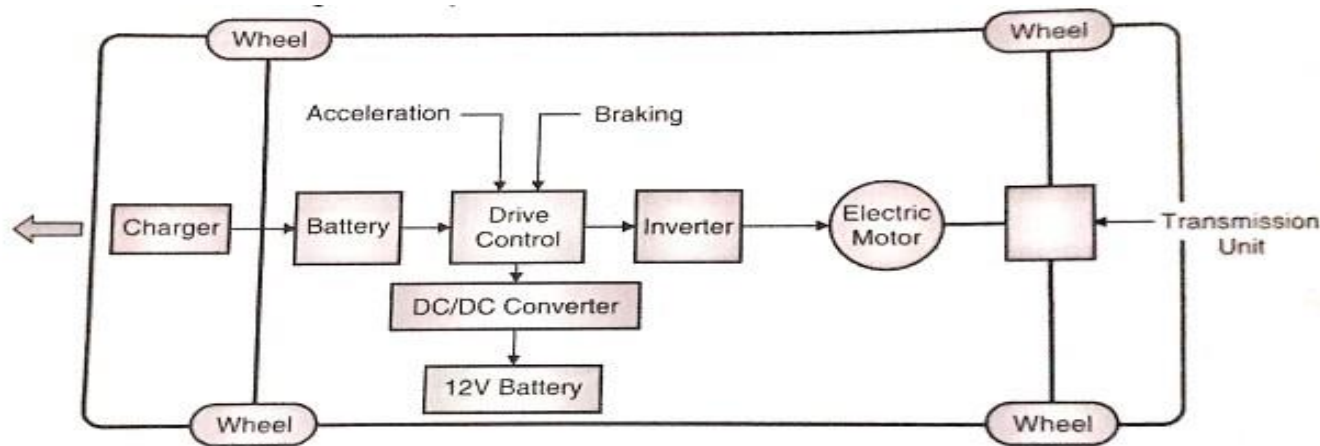
Gradeability Comparison	BB 2523	TATA Prima Lx 2523.K	TATA LPK 2523
Parameter	Crawler Gear	Crawler Gear	1st Gear
Eng Torque	810	900	835
Gear Ratio	14.57	12.868	12.868
Rear axle ratio	4.78	5.58	5.58
Drive line eff	0.95	0.95	0.95
	53,592	61,392	56,958
	1,00,736	1,02,662	1,07,064
Legal GVW	25000	25000	25000
<b>Grade ability</b>	<b>40%</b>	<b>41%</b>	<b>43%</b>

- TATA Prima Lx, & TATA LPK 2523 have higher Gradeability than required to negotiate the gradient in the subject applications.

# Electric \ Battery Vehicle System

## Introduction

- i. Electric powered cars are becoming popular in the present time because of the ever-increasing fuel problems
- ii. Electric cars are known to be very efficient and they consume less energy making them environmentally friendly automobiles.



## Primary Components

1. Charger : the charger gets electricity supplied by electric grid

### 2. Battery

- i. The battery of an electric car can be charged through the use of ordinary grid electricity at a specialized power station.
- ii. But aside from the conventional lithium-ion battery technologies, there are also other major battery technologies which can be used for electric cars.

#### ➤ Lithium-Ion Batteries:

- i. This battery technology gives extra performance and range.
- ii. However, it also carries the highest price tag.
- iii. Lithium-ion batteries are lighter than Lead acid and Nickel metal.
- iv. These are also the batteries used in digital cameras and smartphones.

### ➤ Lead Acid Batteries:

- i. This battery technology is the most popular.
- ii. It is also the cheapest among the battery technologies.
- iii. What's good about it is it's 98% recyclable. Nickel

### ➤ Metal Hydride Batteries:

- i. This battery technology provides higher output and better performance
- ii. it costs much more than lead-acid batteries.

## 3. Drive Control Unit

Drive Control Unit controls the supply of electric current from battery to inverter

#### 4. Inverter

Inverter converts DC supply of battery to AC supply

#### 5. Electric Motor

- i. AC motor or dc motor drives the transmission unit
- ii. If DC motor is used inverter is not required

#### 6. Transmission unit

Transmission unit drives the rear wheel

# Advantages

1.Fuel price Saving

2.No Gas Required

3.No Emissions

Electric cars are 100 percent eco-friendly as they run on electrically powered engines. It does not emit toxic gases or smoke in the environment as it runs on clean energy source.

4. It has limited number of components and are simple in design.

5. Reduced noise pollution

6. Low Maintenance

Electric cars runs on electrically powered engines and hence there is no need to lubricate the engines.

# Disadvantages

## 1. Recharge Points

- i. Electric fueling stations are still in the development stages.

## 2. Electricity isn't Free

## 3. Short Driving Range and Speed

- i. Electric cars are limited by range and speed.
- ii. Most of these cars have range about 50-100 miles and need to be recharged again.

## 4. Longer Recharge Time

While it takes couple of minutes to fuel your gasoline powered car, an electric car take about 4-6 hours to get fully charged.

## 5. Battery Replacement

Depending on the type and usage of battery, batteries of almost all electric cars are required to be changed every 3-10 years.



## 6. Not Suitable for Cities Facing Shortage of Power

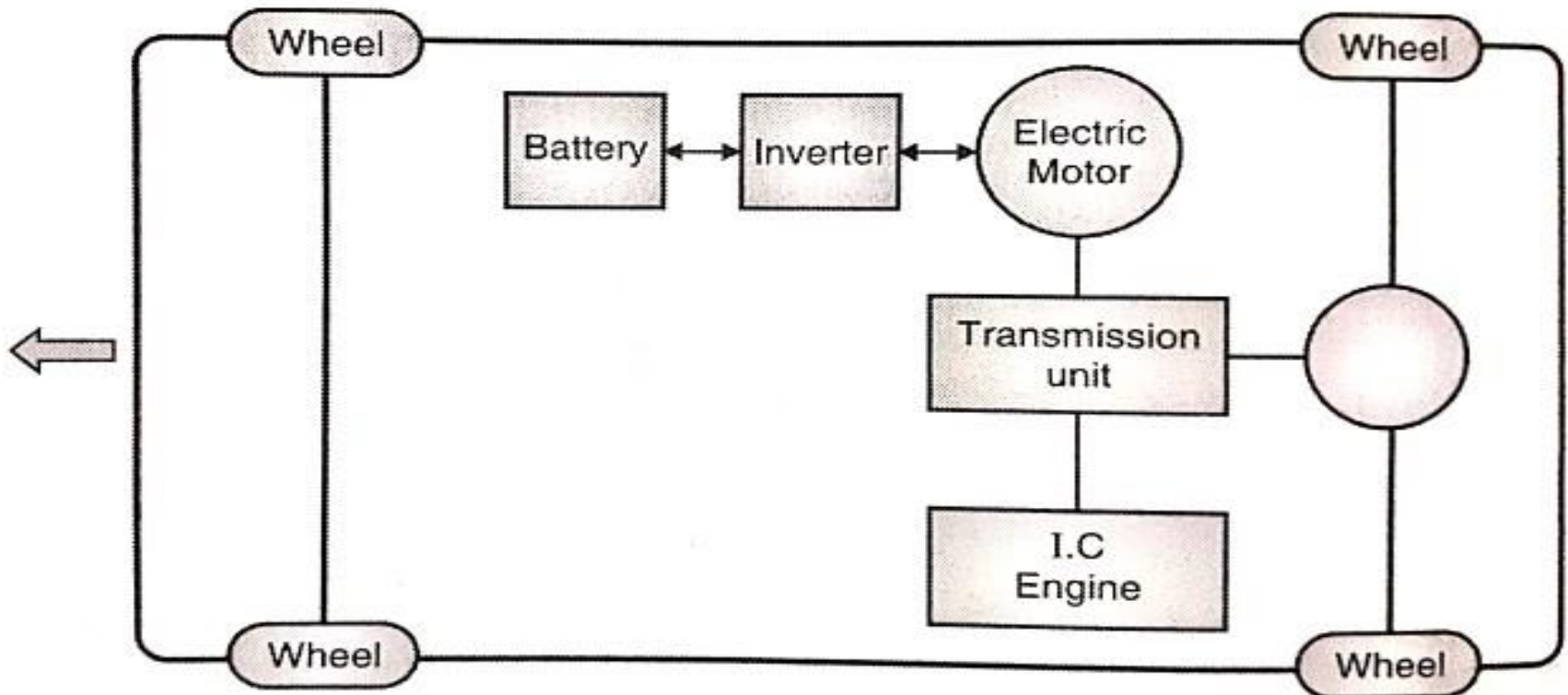
As electric cars need power to charge up, cities already facing acute power shortage are not suitable for electric cars. The consumption of more power would hamper their daily power needs.

<https://youtu.be/0cTHN9RaUiY>

# Hybrid Vehicle System

## Introduction

- i. A hybrid vehicle uses two or more distinct types of power, such as internal combustion engine+electric motor, e.g. Toyota camry hybrid car, ford escape hybrid, Toyota highlander hybrid, honda insight hybrid etc.



## Primary Components

All components of HVS is same as that of EVS only in this engine is also used.

### 1. Charger

the charger gets electricity supplied by electric grid

### 2. Battery

- i. The battery of an electric car can be charged through the use of ordinary grid electricity at a specialized power station.
- ii. But aside from the conventional lithium-ion battery technologies, there are also other major battery technologies which can be used for electric cars.

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#### 5. Electric Motor

AC motor or dc motor drives the transmission unit If DC motor is used inverter is not required

#### 6. Transmission unit

Transmission unit drives the rear wheel

### **Engine**

- i. In this ICE engine as well as electric motor is used to drive the wheels through the transmission unit
- ii. When power demand is low the electric motor acts as generator and utilizes the excess power from engine to charge the battery

# Advantages

- i. A hybrid vehicle runs on twin powered engine (gasoline engine and electric motor) that cuts fuel consumption and conserves energy.
- ii. Hybrid cars are supported by many credits and incentives that help to make them affordable.
- iii. A Hybrid car is much cleaner and requires less fuel to run which means less emissions and less dependence on fossil fuels.
- iv. This also helps to reduce the price of gasoline in domestic market.
- v. Each time you apply brake while driving a hybrid vehicle helps you to recharge your battery a little.
- vi. An internal mechanism kicks in that captures the energy released and uses it to charge the battery which in turn eliminates the amount of time and need for stopping to recharge the battery



5. Weight savings

Many hybrids are constructed using lightweight materials, so they don't consume as much energy as their full-weight counterparts.

6. Cleaner energy

Because hybrids run on a combination of gas and electricity, they emit less pollution than gas-only vehicles.

7. Smaller engines

Because they don't have to power the car alone, the gasoline engines used in hybrid cars are usually small, light, and highly efficient.

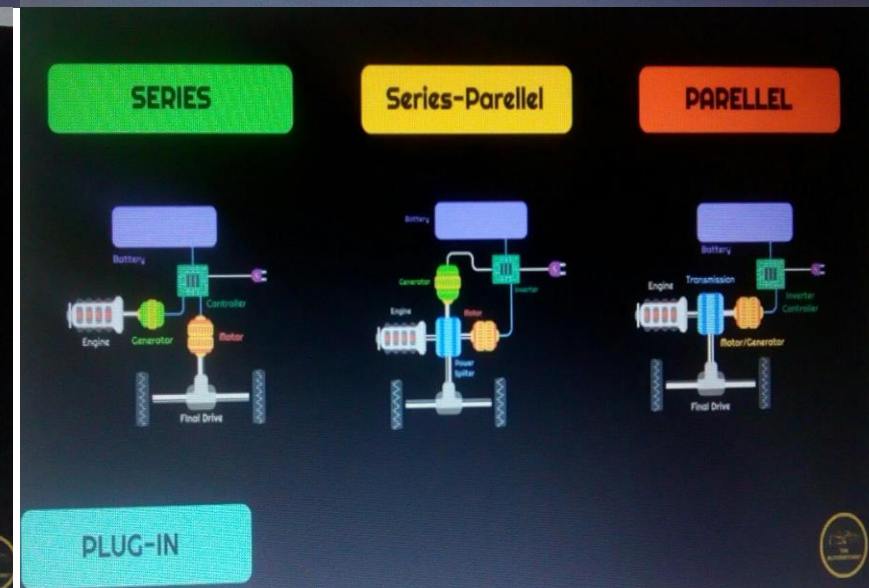
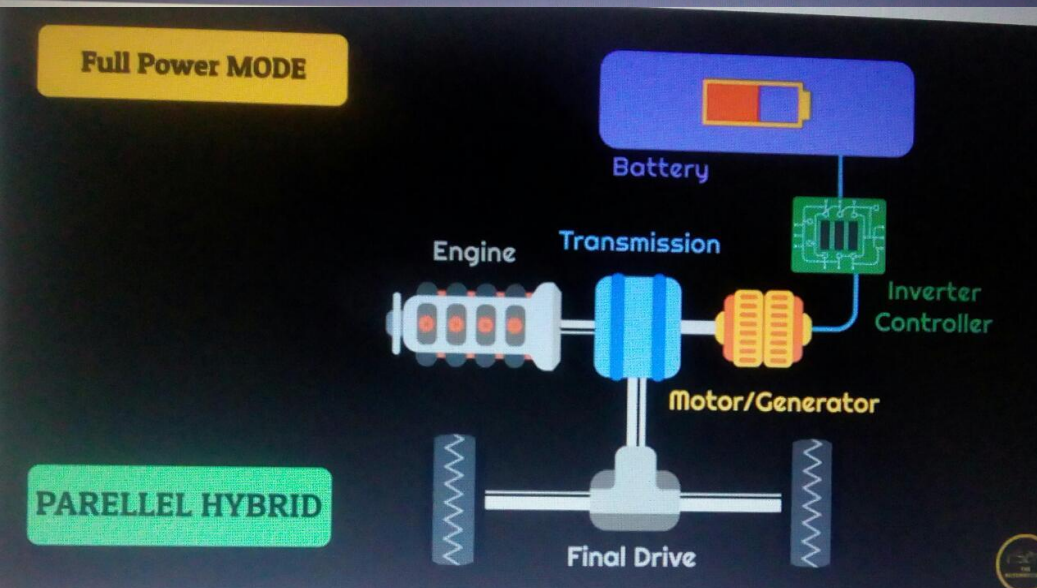
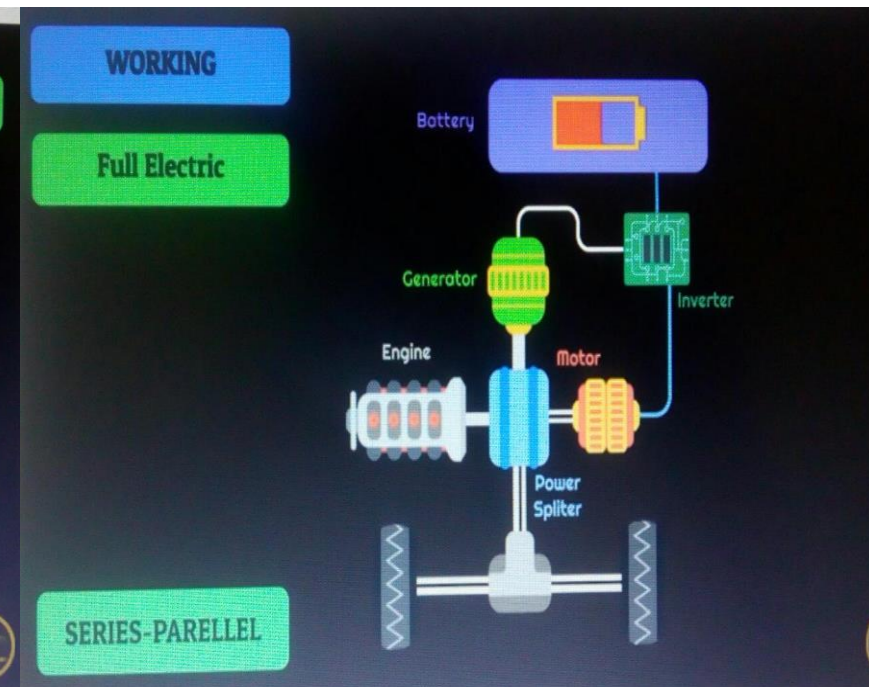
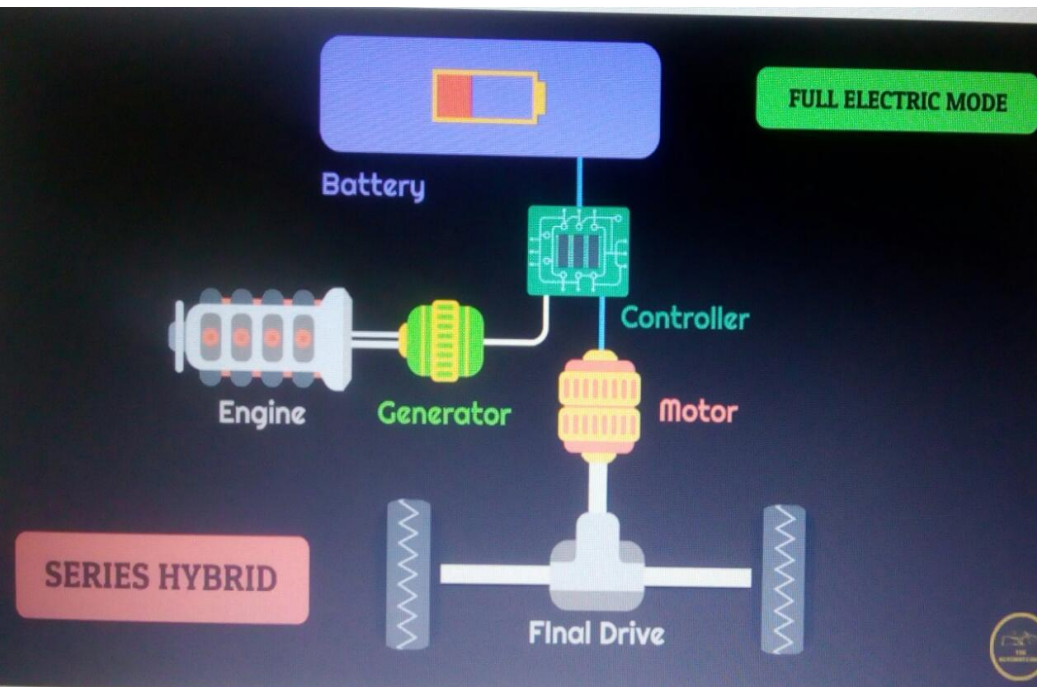
8. Higher resale value

- i. Hybrid versions of popular vehicles remain in high demand on the used car market.

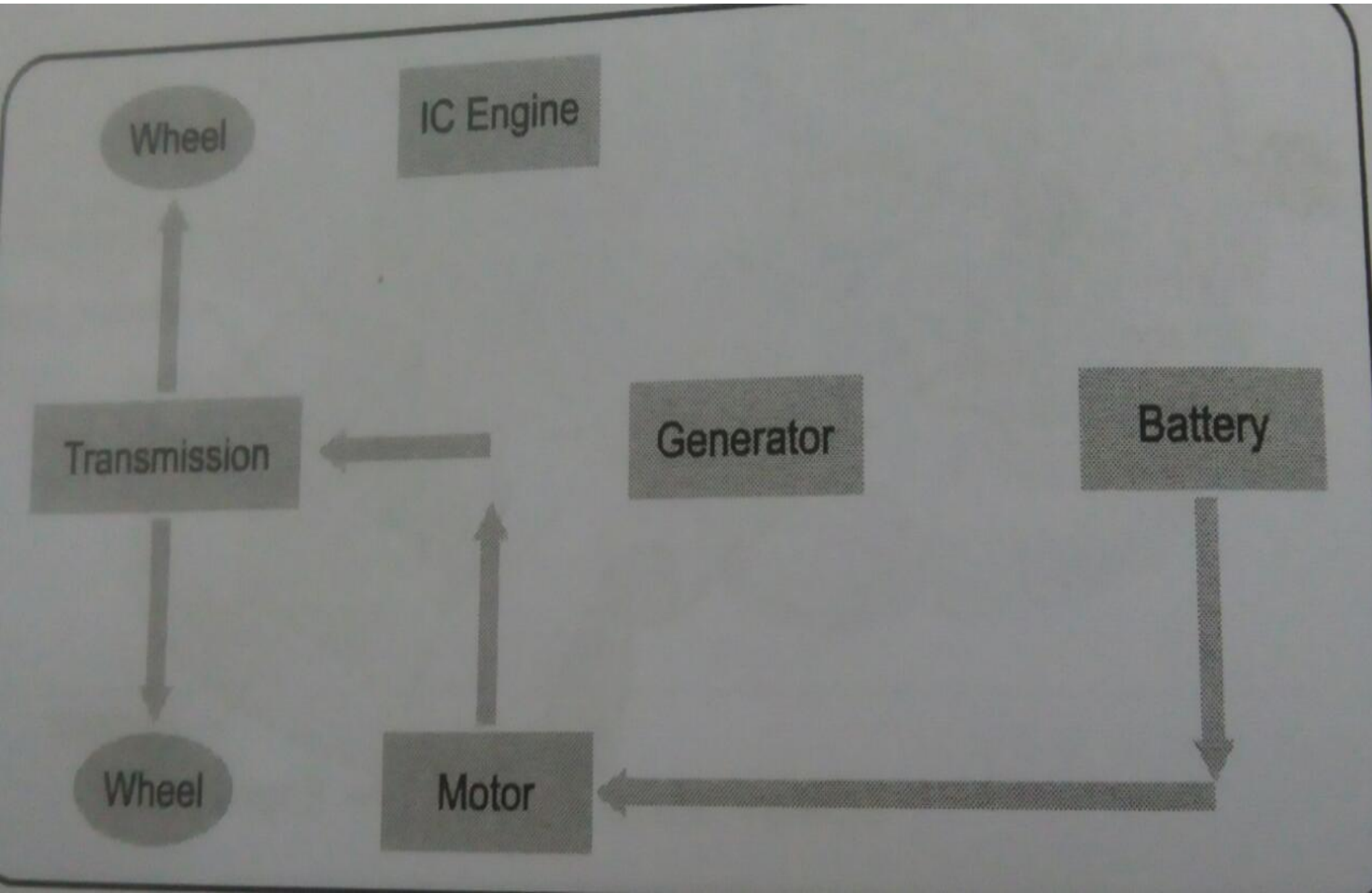
## Disadvantages

1. Expensive to purchase
2. High maintenance cost
3. Hybrid vehicles house more machinery than a regular vehicle, namely a gasoline engine, a light electric motor, and a bunch of batteries.

# Types of Hybrid Vehicles

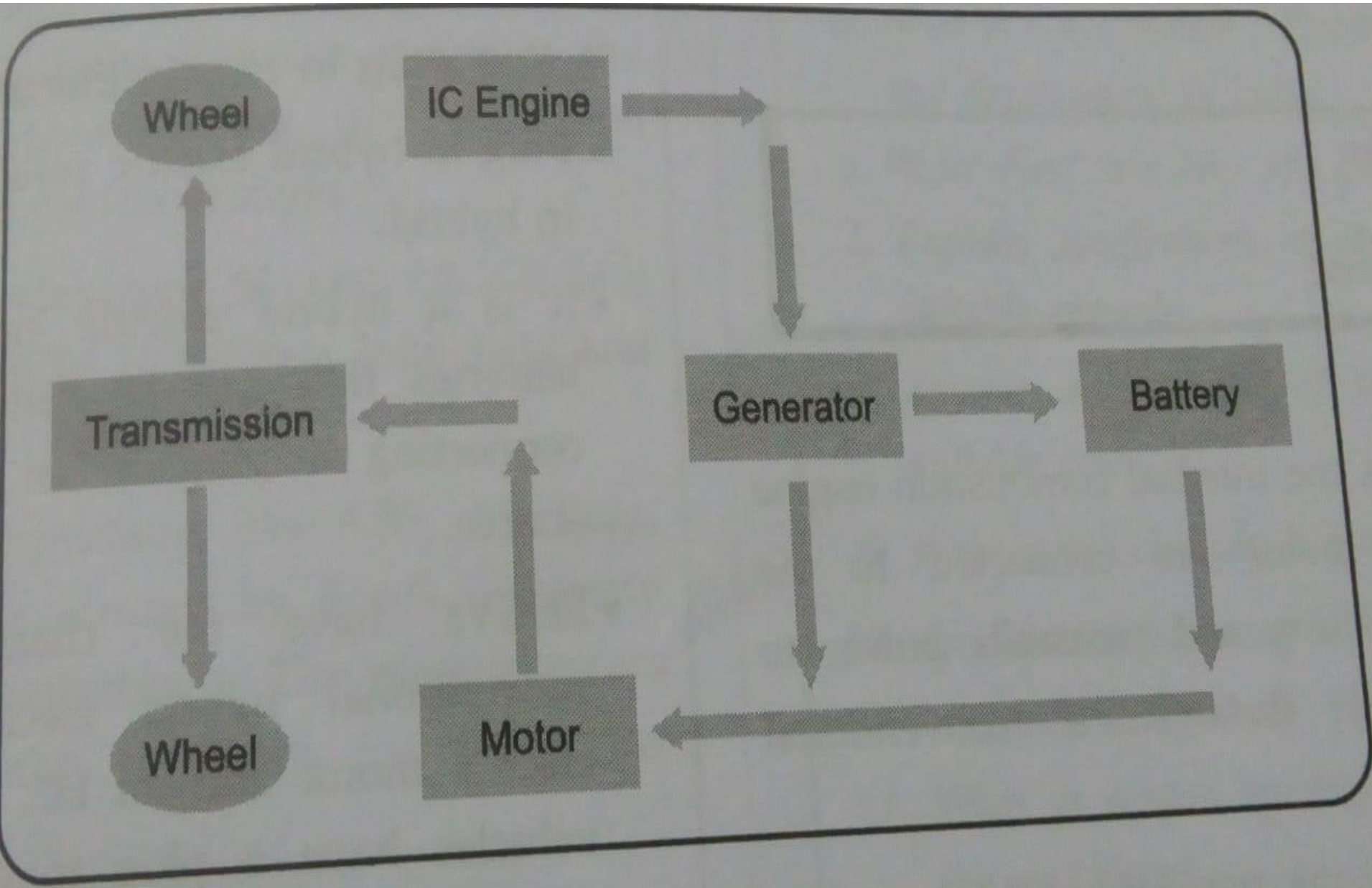


1. **Low Speed**:- power is provided by electric motor using energy supplied by the DC battery

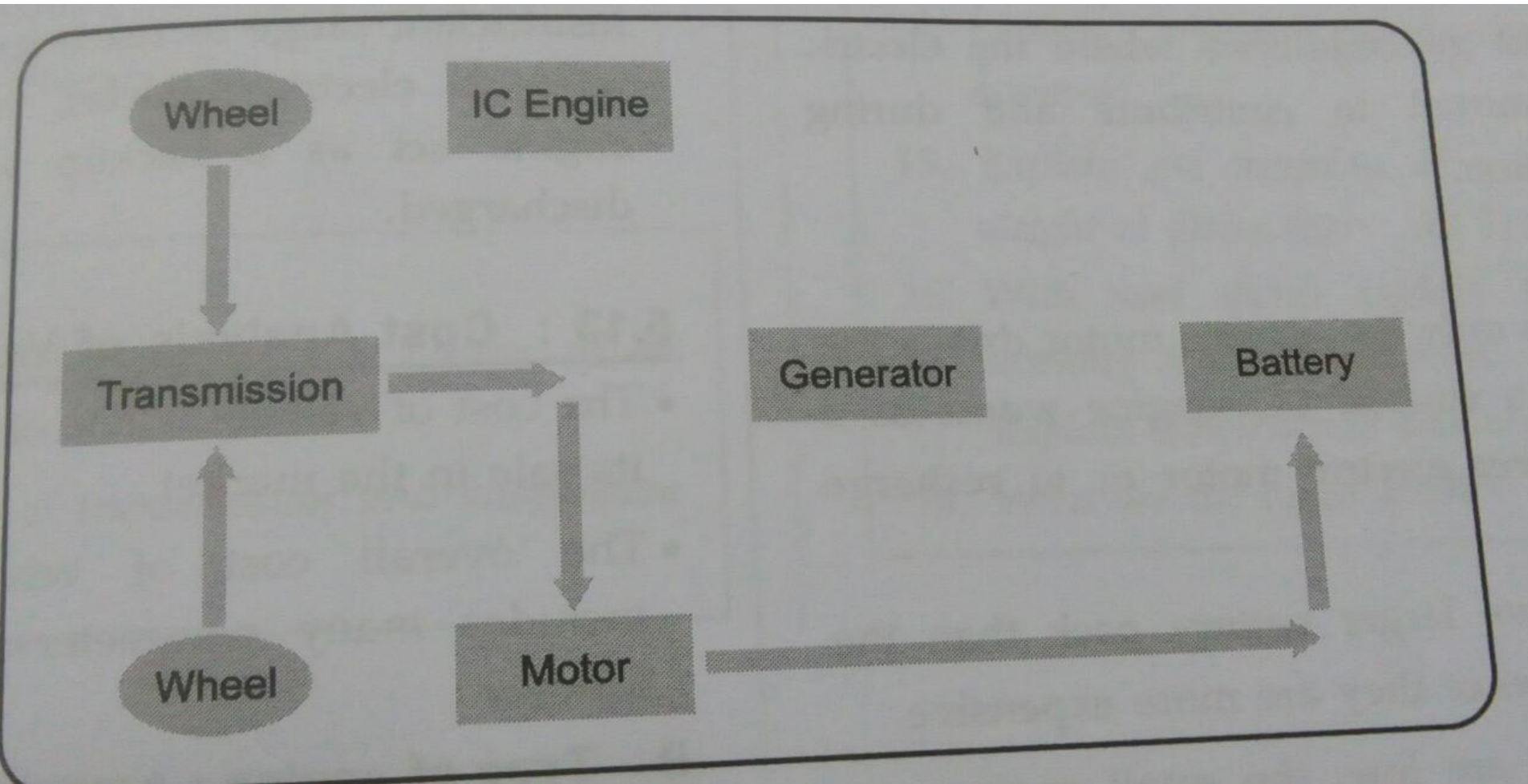




**2.High speed:-** power is provided by IC engine and electric motor via generator.  
Generator charges battery during high speed.



**Braking:-** kinetic energy is converted to electrical energy during regenerative braking by electric motor and supplied to battery

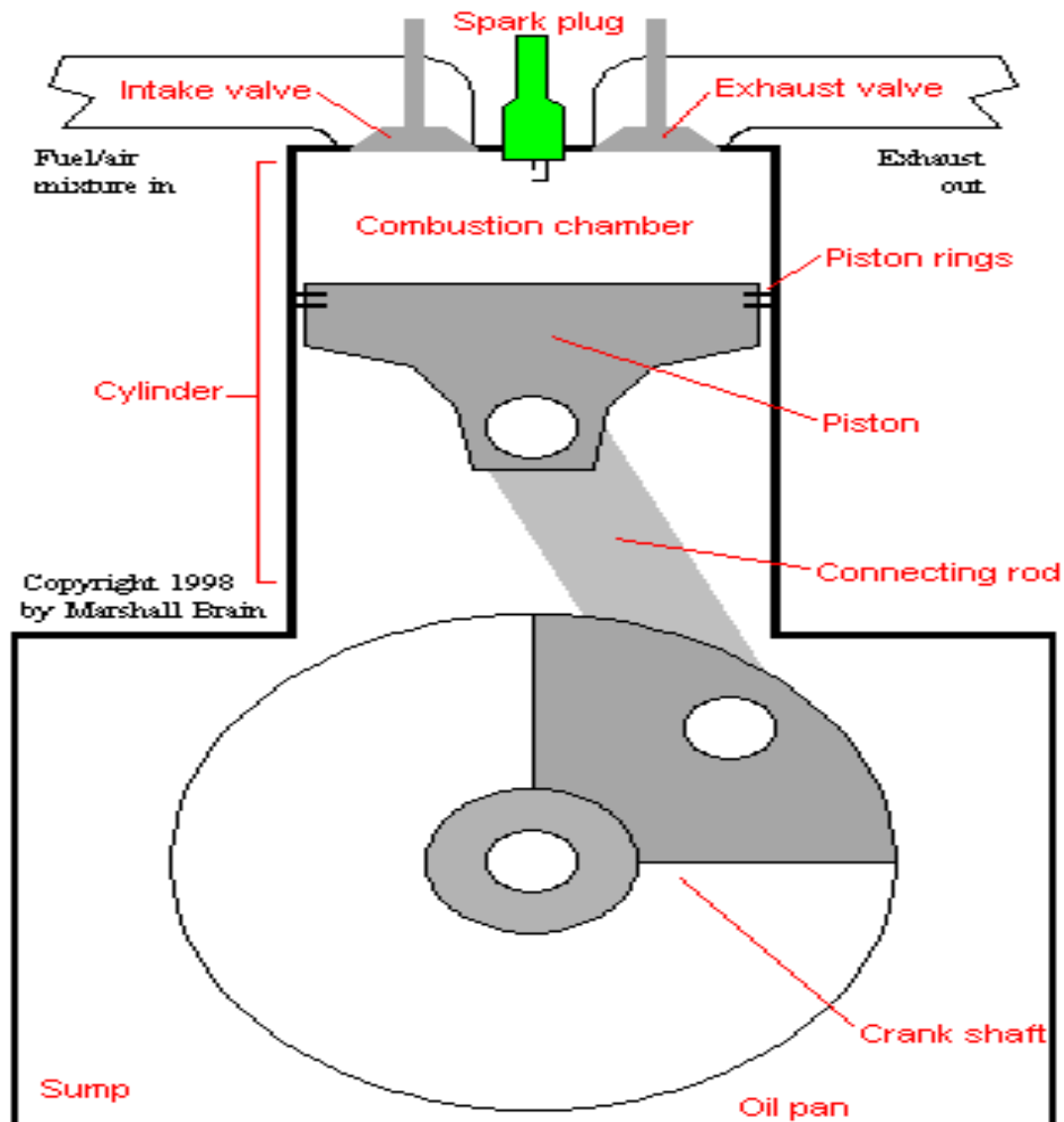




# Characteristics of electric vehicle and I.C engine

Sr. No	Characteristics	I.C Engine	Electric vehicle
1	Initial purchase cost	1.0	1.5 to 1.8 times
2	Running cost	1.0	0.2 to 0.4 times
3	Maintenance cost	high	Negligible
4	Life of vehicle	low	High (except battery)
5	Atmospheric pollution	Very high	No
6	Noise pollution	Very high	moderate

# Engine Components



# Engine Components

## 1. Cylinder block & Crank case:

- To hold engine components, Cooling jacket, crankshaft etc
- Material - Cast Iron, Al alloy

## 2. Cylinder head:

- Spark plug/ Fuel injectors, valve openings, combustion chamber, Mounting for valve operating mechanism
- Material - CI , Al alloy

## 3. Manifolds:

- Inlet & exhaust tubing for AF intake & exhaust
- Material - CI

# Engine Components

## 4. Gaskets:

- For leak proof sealing between two components
- Material - Embossed steel, cork, special rubber

## 5. Piston:

- To transmit the gas force to the crank
- For transmission of force, light weight
- Material - Al alloy, Cast Iron

## 6. Piston rings:

- For leak proof sealing between piston & cylinder, 2 to 4 comp rings & 1 to 2 oil rings
- Material - Alloy CI with Si, Mn with chromium plating

# Engine Components

## 7. Connecting rod:

- For transmitting force on piston to crankshaft
- Converts the reciprocating motion of the piston into rotary motion of the crankshaft
- Material – Al alloy, steel (drop forged from steel), I-section

## 8. Piston/Gudgeon Pin:

- For connecting piston with connecting rod
- Material – Surface hardened steel

## 9. Engine Valves:

- Inlet – for air/AF intake
- Exhaust - for exiting burnt gases
- Material - stainless steels, Ni-Cr-Iron alloys & Titanium

# Engine Components

## 10. Crankshaft:

- To rotate the piston in a reciprocal motion
- CS is connected to flywheel, clutch & main shaft for transmission of power
- Material - Forged from medium carbon steel

## 11. Camshaft:

- For operating valves
- Forged alloy steel

## 12. Silencer/Muffler:

- For reducing exhaust/combustion sound
- Metal sheet



# Terminology used in I.C Engine

1. Bore
2. Stroke
3. Top dead centre (TDC)
4. Bottom dead centre (BDC)
5. Clearance volume
6. Swept volume
7. Compression ratio

# Engine Specification Parameters

1. Fuel Type
2. Engine Type
3. Bore \* Stroke
4. No of cylinders
5. Displacement/Engine Capacity
6. Maximum Power of engine
7. Manufacturer of engine
8. Maximum Torque
9. Fuel Supply System
10. Compression Ratio
11. Engine speed: engine speed is measured in revolutions per minute (RPM).

# Specifications of Maruti swift

Mileage	28.4kmpl
Fuel type	Diesel
Engine displacement	1248
Max power	74bhp@4000rpm
Max torque	190Nm@2000rpm
Seating capacity	5
Transmission type	Automatic
Boot space (litre)	268
Fuel tank capacity	37
Body type	Hatchback
Service cost (5yr	4482

# Specification of Hyundai verna

Mileage	22kmpl
City mileage	18kmpl
Fuel type	Diesel
Engine displacement cc	1582
Max power	<a href="#"><u>126.2bhp@4000rpm</u></a>
max torque	<a href="#"><u>259.87Nm@1500-3000rpm</u></a>
seating capacity	5
Transmission type	Automatic
Boot space (litre)	480ers
Fuel tank capacity	45
Body type	Sedan

# Specification of Toyota Innova Crysta

Mileage	11.36kmpl
Fuel type	Diesel
Engine displacement cc	2755
Max power	<a href="#"><u>171.5bhp@3400rpm</u></a>
max torque	360Nm@1200-3400rpm
Seating capacity	7
Transmission type	Automatic
Fuel tank capacity	55
Body type	MUV

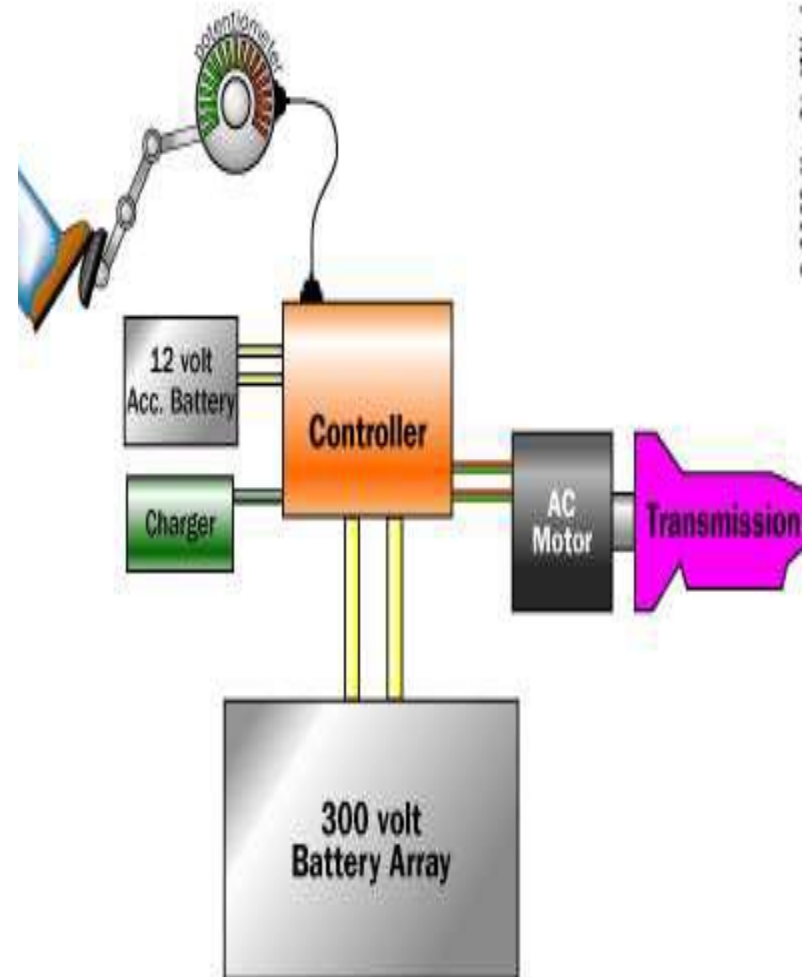
# Comparison of engine specification

Parameter	Two wheeler Yamaha(FZ)	Three wheeler Bajaj Auto	Four wheeler Mahindra Marrazo	Heavy vehicle Bharatbenz
Type	4Stroke Air cooled	4 stroke	4 stroke liquid cooled	4 stroke diesel
Cubic capacity	149	198.88	1497	6372
Number of cyl	1	1	4	6
CR	9.5:1			
Max. HP	9.7kW	7.6kW	90.2 kW	281 kW
Max. Torque	12.8NM	17 NM	300NM	1120 NM
Bore, stroke	57.3*57.9			



# WORKING OF ELECTRIC TRANSMISSION

- The driver presses the accelerator which in turn sends the signals to the controller.
- Depending on the signals received, controller allows voltage supply to the motor.
- Motor is connected to the transmission shaft.
- From shaft mechanical energy is transferred to the wheels through differential gear box.

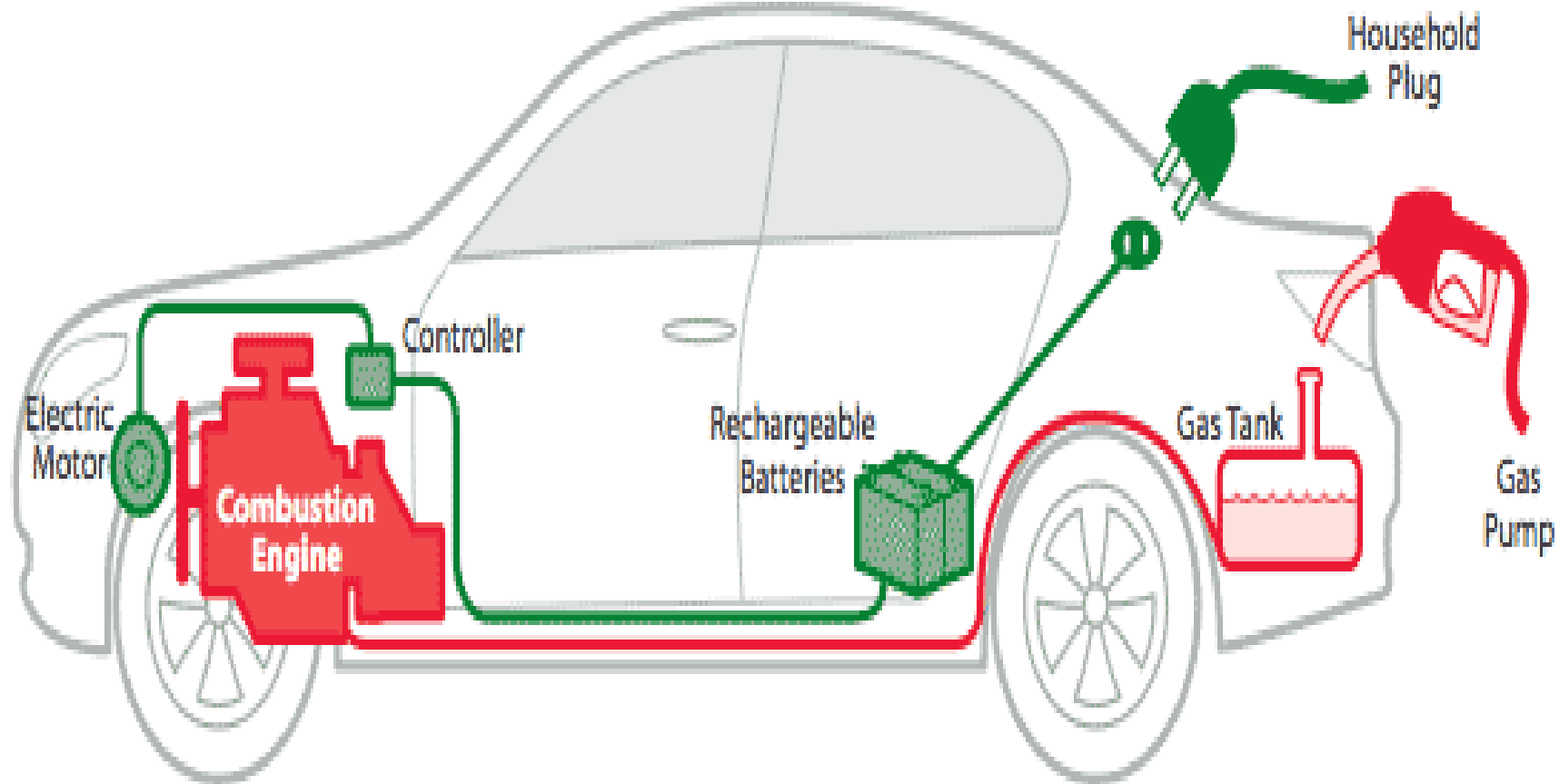


# Advantages of BEV

- Reduce dependence on oil and gasoline
- Air pollution and noise free.
- Rechargeable batteries
- Simple in design
- Low maintenance and operation cost

# Disadvantages of BEV

- High initial cost
- High recharge time
- Low speed



# Cost Analysis of Vehicles

Parameters	Vehicle Cost High	Vehicle cost Low
Torque	Increase in Torque	Decrease in torque
Speed	Increase in speed	Decrease in speed
No. of cylinders	Increase in no. of cylinders	Decrease in no. of cylinders
Type of brakes	Disk brake Hydraulic brakes Pneumatic brakes	Drum shoe brakes
Type of Engine	High power engine	Low poer engine
Safety features	More safety	Less safety
Material of the vehicle	High grade material	Low grade material

# Cost Analysis of Vehicles

- Royalty
- Dealer profit
- Insurance and taxation
- Availability of spare part
- Advertisement
- Quantity of production
- Labour cost

# Cost Analysis of Vehicle

## Objective

- i. The purpose of this decision aid is to facilitate the cost calculation for a vehicle.
- ii. The program is useful for enterprise budgeting, estimating transportation costs and evaluating vehicle purchasing alternatives.

## Type of costs

1. Variable cost
2. **Fixed Costs**

### 1.Fixed Costs

- i. Fixed costs are those costs that continue whether the vehicle is used or not.
- ii. Fixed costs include depreciation cost, ex showroom price + (registration cost, insurance, and interest costs).



a. Depreciation

- i. Depreciation is a measure of the actual loss of value in the vehicle that occurred in the current year.
- ii. Thus, it may be different than depreciation used for tax purposes.
- iii. The formula takes the fraction of remaining life used in the current year and multiplies it by the current market value of the vehicle less salvage value.

b. Interest Costs

Interest costs include actual financial charges on the loan  
Required to purchase the vehicle

c. Registration and vehicle taxes

It the amount spent on registration and paying vehicle taxes

## 2. Variable Cost

- i. Variable costs are those costs that vary directly with the amount the vehicle is used.
- ii. If the vehicle is not used, these costs are eliminated. Variable costs

### Various Variable Cost

- maintenance costs
- fuel and oil cost
- repair cost
- toll cost
- Parking cost
- Driver cost

# Use of battery & its capacity

EV make	Battery	Range km (mi)
BMW i3 (2019)	42kWh	345km (115)
GM Spark	21kWh	120km (75)
Fiat 500e	24kWh	135km (85)
Honda Fit	20kWh	112km (70)
Nissan Leaf	30kWh	160km (100)
Mitsubishi MiEV	16kWh	85km (55)
Ford Focus	23kWh	110km (75)
Smart ED	16.5kWh	90km (55)
Mercedes B	28kWh (31.5)*	136km (85)
Tesla S 60	60kWh	275km (170)
Tesla S 85	90kWh	360km (225)
Tesla 3	75kw	496 (310)

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THANK YOU