Unit III :- Vehicles & their Specifications (04 HRS.)

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Contents:-

- Classification of automobiles, Vehicle Specifications of two/three wheeler, light motor vehicles, trucks, buses & multi-axle vehicles. 1 Hr
- Engine components (Introduction), Study of engine specifications. Comparison of specifications of vehicles 1 Hr
- Introduction of Electric & Hybrid Vehicles 1 Hr
- Cost analysis of Vehicles. 1 Hr

- Vehicle is a device or machine which is used to transport human ~~vehi~~ bei as well as goods, specially on roads.
- ex. Bicycle, Motorcycle, cars, autorikshaws, trucks, buses, Bullcart etc.
- An Automobile vehicle is capable of propelling itself.

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* An automobile is a vehicle that is capable of propelling itself

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* Classification of Automobiles:-

A. Based on purpose:-

1. Passenger Vehicles:-
   These carry passengers. ex. Buses, cars, trains.
2. Goods Vehicles:-
   These carry goods from one place to another.
   ex. Goods carrier, trucks, Goods lorry.
3. Special purpose vehicles:-
   These vehicles include Ambulance, fire engines, Army vehicles etc. used for special purposes.

Q. Do you know any special purpose vehicle?

B: Based on load Capacity:-

1. Heavy Motor Vehicle - Large & Bulky like trucks
2. Medium load Vehicle - Small trucks, mini buses
3. Light Motor Vehicle - Small size like cars, jeeps.

C Based on Fuel Source:-

1. Petrol engine vehicles - Use petrol - scooters, cars etc.
2. Diesel engine vehicles - Use diesel - Trucks, buses
3. Gas Vehicles - use gas to run a gas turbine
   ex. turbine powered cars, bike - MTT Y2K,
4. Electric Vehicles - use electricity as power source.
   ex. electric cars & buses. Mahindra e-Verito, e20+
5. Solar Vehicles - powered by solar energy - ex. Sah Empire
6. Hybrid Vehicles - Vehicles that use two or more distinct power sources. ex. hybrid cars, buses. Toyota Prius, Honda insight

D. Based on type of Transmission:-

1. Automatic Transmission Vehicles - These are capable of changing gear ratios automatically as they move.
   ex. Renault kwid, Tata Nexon, Toyota Yaris, Honda Amaze Hyundai Verna, Maruti Suzuki Celerio etc.

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2. Manual transmission Vehicles:- These facilitate manual gear changing with a clutch pedal.
ex. Hyundai i10, Maruti Suzuki Ritz, Alto, Celerio etc.

3. semi-automatic transmission Vehicles:-

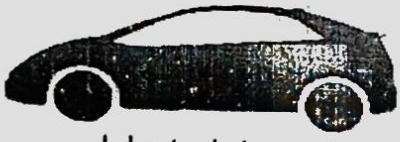
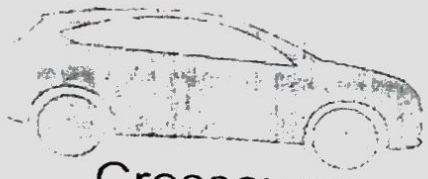
Semi-automatic transmission is just manual transmission but without clutch pedal.
ex ford fiesta, Honda ishift, Fiat Punto, etc

E Based on number of wheel:-
1. Two wheeler - having two wheels. ex. scooters, motorcycles
2. Three wheeler - ex Tricycles, Auto rikshaws, Tempos.
3 Four wheeler - cars, jeep
4. Six wheeler - Large trucks, buses.

F Based on Engine cc (Cubic Centimeter Capacity)
1. Small cars (upto 1000 cc)
Chevrolet spark, Honda insight, Hyundai Eon, Maruti Alto, Estelo, Wagon R, Tata Nano.
2. Medium cars (1000-2000 cc)
Ambassador, Audi A4, BMW 328i, Fiat Palio, punto, Honda City, civic, Hyundai Santro, Verna, Mahindra Varito, Maruti swift, Estiga, Tata indica, Indigo etc.
3. Large cars (More than 2000 cc)
Mitsubishi pajero, BMW 530d, i, Chevrolet Tavera, Honda Accord, Lamborghini Aventador, Mahindra Bolero, Scorpio, Xylo, Tata Safari, Sumo, Toyota Innova etc.
4. Transport Vehicles
Tata Ace, Mahindra Axe, Ashok Leyland Comet, Panther, Bajaj Tempo, force one truck, Land Rover Freelander, Volvo city Bus, etc.
5. Electric / Hybrid Vehicles
Mahindra e20.

8 List any five vehicles and mention their engine cc. What is does the engine cc effect while driving?

Types of Cars Common Commuter Cars

Car Type Based on Body Type	Description
 Sedan	Most common kind of car on the road Engine at the front 4 doors Has a trunk that is separated fromt the passengers by the rear seat Examples include the BMW 3-series and the VW Jetta
 Coupe	2 doors Sometimes has functional rear seat Examples include the BMW 4-series and Scion TC
 Hatchback	Usually smaller than a sedan and has either 2 or 4 doors Only 2 windows on the sides, excluding small side or corner windows Trunk is a hatch that opens up into the passenger compartment Sometimes referred to as 3-door or 5-door Examples include the Ford Focus and VW Golf
Wagon	Has a hatch on the back and 3 windows on the side Usually models that also exist as sedans Examples include the Audi Allroad and Volvo V70
 Crossover	Come in a variety of shapes and sizes Combines the large dimensions of an SUV and the chassis of a car Looks like a hatchback on stilts Easy to confuse with a small SUV Examples include the Nissan Murano and Porsche Macan
 Minivan	Bigger and longer than a crossover 3 rows of seats that sits on a car chassis Usually a sliding door on one or both sides that allow for easy entry Examples include the Toyota Sienna and Dodge Caravan
SUV	Very large On a truck chassis, usually with the body sitting on top of the frame May be similar looking to crossovers Examples include the Chevy Tahoe and Porsche Cayenne

Vehicle Specifications :-

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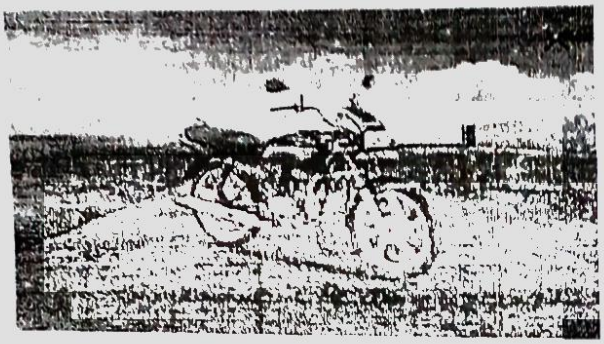
* Two Wheeler :-

- Engine Type - Single Cylinder, 4-stroke, SI engine, etc.
- Displacement - In cc - Total swept vol. of all cylinders.
- Max. power - In bhp @ - RPM
- RPM - Rev. per min. of crankshaft.
- Brake system - Disc or drum etc.
- Fuel Capacity - in lt. with Reserve Capacity.
- Max. Torque - in Nm @ RPM
- Drive type - Chain drive
- Fuel supply - Carburetor or fuel injection
- Clutch - Wet multiplate.
- Transmission - Manual, automatic
- Gear box - 5 speed, 4 speed, & CVT or 6 speed.
- Max. speed - 85 - 250 Kmph
- 0-60 Kmph - 10 - 5 sec.
- Chasis - Diamond, Tubular, Underbone, twosection.
- Suspension - Telescopic, mono, twin, Telelever.
- Length, width, height - 150 - 195 mm
- ground clearance
- Tyre size - 80/100-17, 90/90-12, 130/70-17 etc.
- Tyre type - Tubeless.
- Mileage - 40 Kmpl, etc

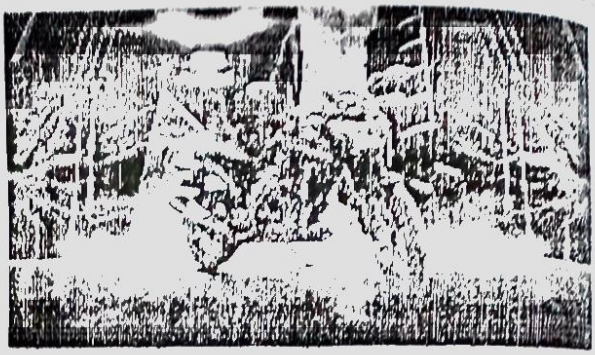
17 inch diameter
80 mm width (mm)
100 - height from rim (mm) x 100
width
(Aspect Ratio)

Q. Write down specification of your own vehicle.

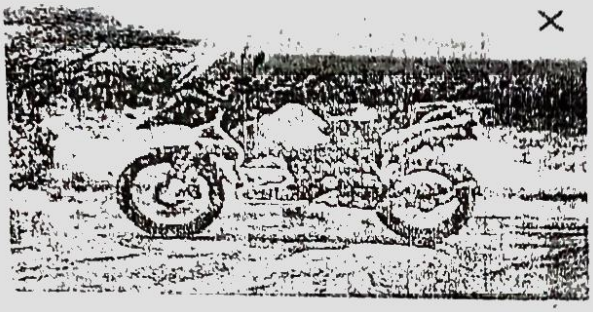
* Comparison of Specifications of Two Wheeler Vehicl



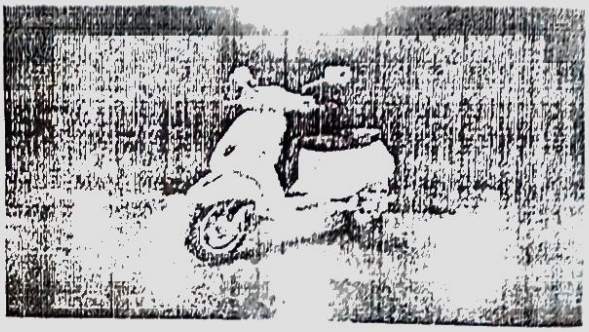
Hero Splendor Plus



Honda XBlade



BMW R 1200 GS Adventu...



Vespa ZX 125

Specifications\Model	Splendor Plus	Honda Xblade	BMW R1200	Vespa ZX125
Price	59807	95097	1922000	95494
Mileage	80.6	45	16	60
Engine Type	Single Cylinder, 4 stroke SI Engine	Single Cylinder, 4 stroke SI Engine	Flat Twin Engine 4 Strokes DOHC	Single Cylinder, 4 stroke SI Engine
Displacement	97.22 cc	162.71 cc	1170 cc	125 cc
No. of cylinders	1	1	2	1
Max. Power	8.36 PS @ 8000 rpm	14.12 PS @ 8500 rpm	125 PS @7750 rpm	10.5 PS @ 7500 rpm
Max. Torque	80.5 Nm@5000 rpm	13.9 Nm @6000 rpm	125 Nm @6500 rpm	10.6 Nm @6000rpm
Rear brake	Drum Brake	Disc Brake	Disc Brake	Drum Brake
Fuel Capacity	10.5 L	12 L	30 L	7 L
Cooling System	Air Cooled	Air Cooled	Air & Liquid Cooled	Air Cooled
Drive Type	Chain Drive	Chain Drive	Shaft Drive	Belt Drive
Starting	Kick Start	Self Start	Self Start	Kick & Self Start
Fuel Supply	Carburetor	Carburetor	Fuel Injection	Carburetor
Clutch	Multi Plate wet	Multi Plate wet	Oil Lubricated Hydraulic	Automatic
Gear Box	4 Speed	5 Speed	6 Speed	Automatic
Max Speed	87 KMPH	110 KMPH	250 KMPH	90 KMPH
0-60 Kmph	12.2 Sec	5.3 Sec	3.7 Sec	5.1 Sec
Chassis	Tubular Double Cradle	Diamond	Two Section Frame	Monoscope
Tyre Size	Front & Rear 2.75 - 18	Front 80/100 17 Rear 130/70- 17	Front 120/70 19 Rear 170/60-17	Front & Rear 90/100 10.53
Tyre type	Tubeless	Tubeless	Tubeless	Tubeless

tyre - 2.75-18

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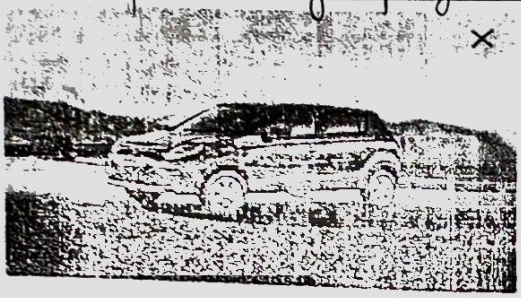
* Light Motor Vehicles :-

- Fuel type – Petrol, diesel, hybrid, electric
- Engine displacement – in cc.
- Body type – Hatchback, sedan, MUV, SUV etc
- Max. Power – bhp @ RPM
- Mileage – 10-25 Kmpl
- Fuel tank Capacity – in lt
- Seating Capacity – 4-5 or 7
- Transmission – Manual, Automatic
- Tyre size – 145/80, R12 → 145mm width, 80% Aspect Ratio, Radial 12 inch diameter.
- Tyre type – Tubeless
- ~~Fuel~~ Top Speed – 140 Kmph etc.
- Engine type – F8D Petrol, U2 CRDi Diesel, Petrol iVTEC etc
- Max. Torque – ~~bhp~~ Nm @ RPM
- No. of cylinders – 3, 4, 6
- Fuel supply System – MPFi, CRDI, DOHC etc.
- Gearbox – 5, 6 speed, e-CVT,
- Dimensions – Length, Height, width, ground Clearance etc.
- Suspension – Mcpherson Strut, Double wishbone torsion ba
- Steering type – Power Steering
- Break types – Solid disc, disc, drum etc.
- Accelaration – 19, 11.31 etc
- Breaking time – 3.33 sec. etc.

* Comparison of Specifications of 4-Wheeler Vehicles :-

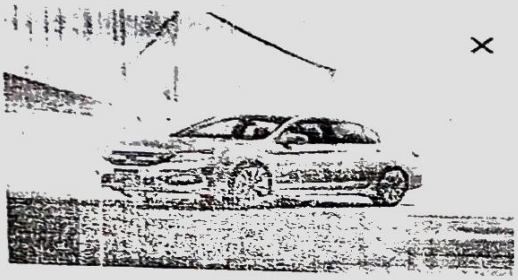


Maruti Alto 800

Maruti Alto 800 STD

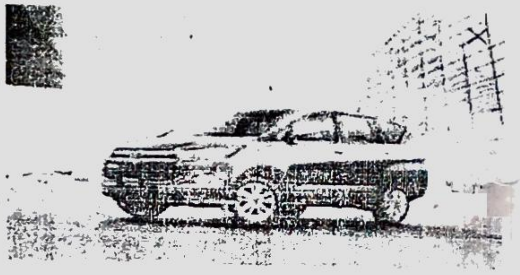
Hyundai Xcent

Hyundai Xcent 1.2 CRDi



Honda Accord

Honda New Accord Hyb



Toyota Innova Crysta

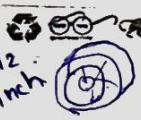
Toyota Innova Crysta 2

Specifications\Model	Maruti Alto 800	Hyundai Xcent	Honda Accord	Toyota Innova Crysta
Price	294000	873000	4321000	1605000
Fuel Type	Petrol	Diesel	Petrol	Diesel
Engine Displacement	796 cc	1186 cc	1993 cc	2393 cc
Max. Power	47.3bhp @6000 rpm	73.97bhp @4000 rpm	143.01bhp @6200 rpm	147.8bhp @3400 rpm
Max. Torque	69 Nm @3500 rpm	190.24 Nm @2200 rpm	175 Nm @4000 rpm	343 Nm @ 2800 rpm
Mileage	24.7 Kmpl	25.4 Kmpl	23.1 Kmpl	13.68 Kmpl
Fuel Tank Capacity	35 L	43 L	60 L	55 l
Transmission Type	Manual	Manual	Automatic	Manual
No. of Cylinders	3	3	4	4
Fuel Supply System	MPFi	CRDI		Direct Injecion
Gear Box	5 Speed	5 Speed	e-CVT	5 Speed
Shock Absorber Type	Gas Filled	Gas Filled	Telescopic	Coil Spring
Steering Type	Manual	Power	Power	Power
Braking System	Front Disc Rear Drum	Front Disc Rear Drum	Front Disc Rear Disc	Front Disc Rear Drum
Top Speed	140 Kmph	156 Kmph	240 Kmph	180 Kmph
Power Steering	No	Yes	Yes	Yes
Driver Airbag	Yes	Yes	Yes	Yes
Passenger Airbag	No	Yes	Yes	Yes
Seating capacity	5	5	5	7
Tyre size	145/80 R12	175/60 R15	235/45 R18	205/65 R16

Body Type — Hatchback, Sedan, Hybrid, MUV

MPFi - MultiPoint Fuel Injection
CRDI - Common Rail Direct Injection

Petrol - exact regd qty of fuel, optimum Air-fuel ratio. Perfection combustion
Diesel



145/80 R 12 — wheel rim dia in inch

14 - dia in inch

165 - Width mm
80 - aspect ratio
R - Radial ply tyre

Height of tire is 80% of width — sidewall

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Specification of trucks:-

- Engine Cylinders – 6
- Displacement – 2953 – 12800 cc
- Max. Power – 205 – 480 bhp @ 2000 rpm
- Max. Torque – 284 – 2400 Nm @ 1500 rpm
- Transmission – Manual
- Clutch – Single dry plate, Hydraulic Control etc.
- Gearbox – 5, 9 or 14 speed.
- Fuel Tank – 90 – 290 lt
- Mileage – :
- Body type – Fully built or Trailer body
- Chassis type – Chassis with cabin
- Cabin – Day or sleeper
- Payload – in kgs.
- Parking brakes – Yes
- Power steering – Yes
- Fog lights – Yes

Specification of Buses:-

- Engine Cylinder – 6
- Displacement : – 6900 cc around
- Max Power & Torque – 123 – 220 bhp @ 2400 rpm & 400 – 800 N/m @ 1300 – 1800 rpm
- Transmission → Automatic or Manual
- Gearbox – 6 speed
- Fuel Tank – 160 – 335 lt.
- Engine location – Front
- Passenger door – Yes
- Side windows – Yes
- Emergency exit – Yes.
- No. of seats – 34 – 40 Seater
- Parking brakes – Yes
- Hatrack – Yes
- Entertainment Package – Optional

Engine Components

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The engine of an automobile vehicle provides the motive power for all the various functions which the vehicle or any part of it, may be required to perform.

The main part of an automotive engine are:-

1. Cylinder block & Crankcase.
2. Sump or oil pan
3. Gaskets
4. Cylinder head
5. Manifolds
6. Cylinders
7. Pistons
8. piston rings
9. Connecting rods
10. Piston pin.
11. Crankshaft.
12. Main Bearings
13. Valves & Valve actuating mechanisms.
14. Muffler.

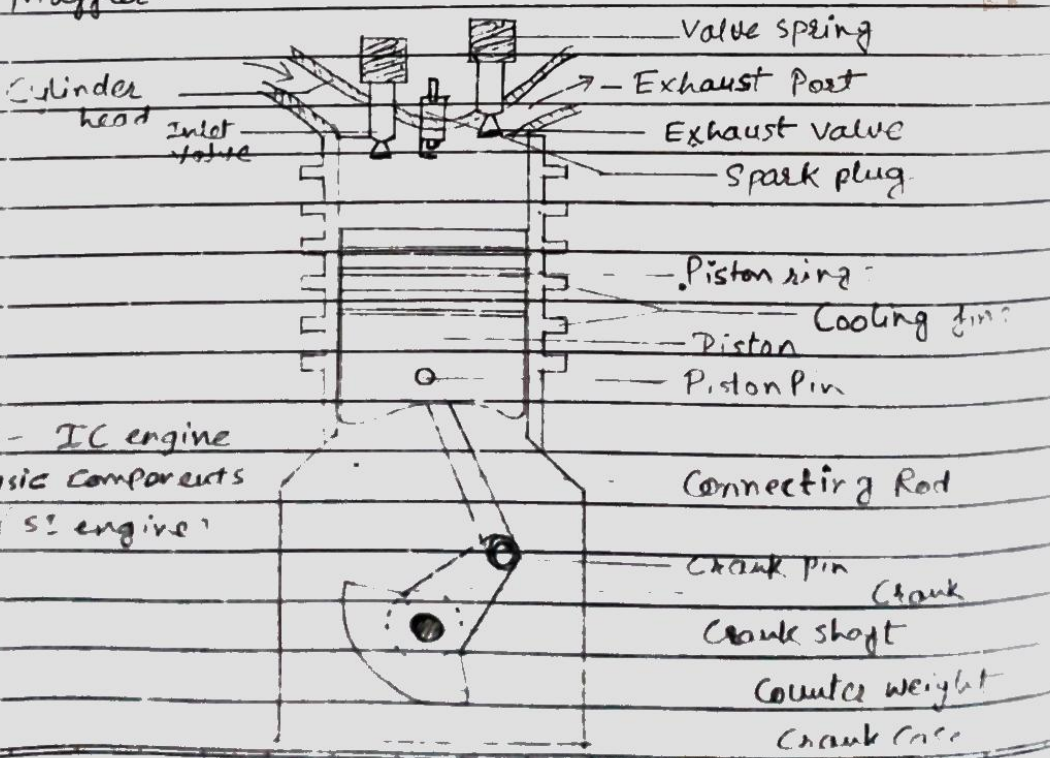

Fig:- IC engine basic components (S.I engine)

Engine Specifications

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- Manufacturer – Name of Company.
- Model – Year of manufacturing
- Type – Petrol, diesel, 4-stroke, inline or V etc.
- Bore – It's dia. of cylinder in mm.
- Stroke – Distance travelled by piston in moving from TDC to BDC.
- Displacement – Vol. swept by ~~pist~~ All pistons from TDC to BDC
- Max. Power – Max. power (kW) which engine can produce
- Max. Torque – Max. force of Rotation about crankshaft axis.
- Power to weight Ratio – Ratio of power of engine to ~~it's~~ weight
- ~~Power to torque Ratio~~ – (Similarly Torque to weight) of vehicle.
- Specific Output – Ratio of Power of engine to it's displacement.
- Valve Gear – No. of types of inlet & exhaust valves.
- Fuel System – Common rail, direct injection, MPFI.
- Fuel tank Capacity – Max. fuel that can be filled.

Ex:- Engine Specifications for Scorpio Petrol SUV

- Manufacturer – Mahindra & Mahindra Ltd.
- Engine type – 4-cylinder inline, petrol engine.
- Bore – 82.7 mm
- Stroke – 93.0 mm
- Displacement – 1998 cc
- ~~Max~~ Power – 86.5 kW at 5500 rpm
- Max Torque – 183.4 Nm at 3800 rpm
- Power to weight Ratio – 50 kw/tonne
- Specific Output – 43.3 kw/lt
- Valve Gear – 4 Valves per cylinder, DOHC
- Fuel System – Segmental MPFI.
- Torque to weight Ratio – 106 Nm/tonne

Q. Write down engine Specifications of vehicle you own.

Introduction to Electric & Hybrid Vehicles

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Electric Vehicle :-

A general layout of an electric vehicle is as shown below :-

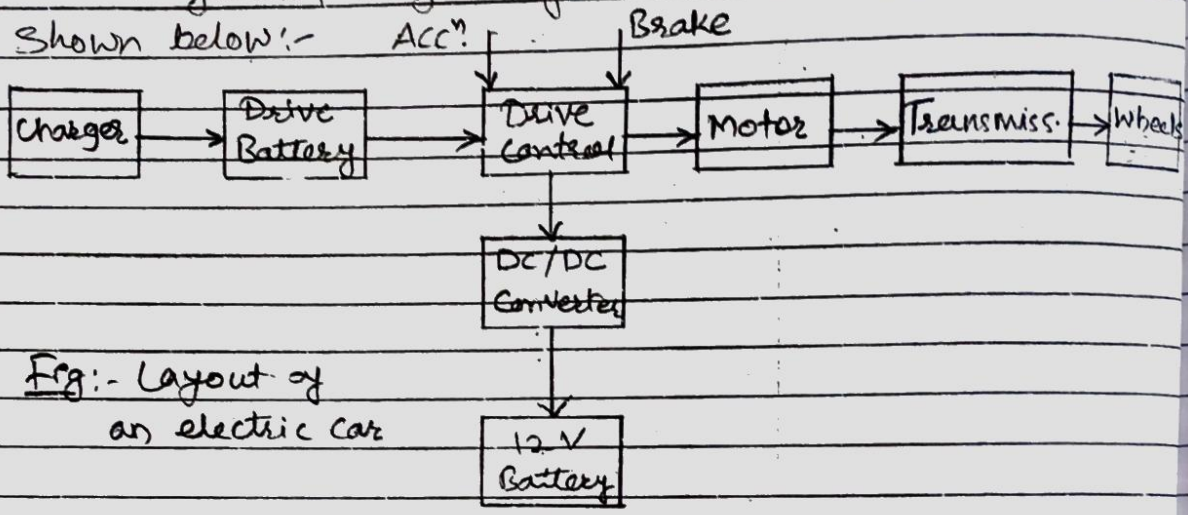

Fig :- Layout of an electric car

In electric vehicle, engine is replaced by electric motor & the battery used is lead-acid type. The drive controller takes power from batteries & delivers it to motor. There are many types of drive motors to choose from. A DC Shunt wound motor of about 50 KW rating is common. Apart from drive batteries 12 V / 24 V batteries are also required for rest of vehicle electrical systems which may be charged when required from drive batteries.

Advantages :-

- Rapid Acceleration
- Regenerative braking
- Noice free operation.
- No loss of power in idling
- High reliability
- Easy to drive.
- Easy maintainance.

Disadvantages :-

- Range is limited because of need to recharge batteries.
- Top speed is low (about 60 Kmph).
- Life of batteries is short. & hence high replacement cost

Example :- e20 from Mahindra.

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Hybrid Vehicle :-

The combination of Internal combustion engine & electric motor result in a hybrid vehicle. The optimum strategy for hybrid vehicles is to use electric drive during slow moving city traffic & for acceleration and for hill climbing & IC engine at cruising speeds on highways. This would result in reduced pollution in cities and improved mileage.

In most of hybrid vehicles parallel hybrid systems are used, a general layout is shown :-

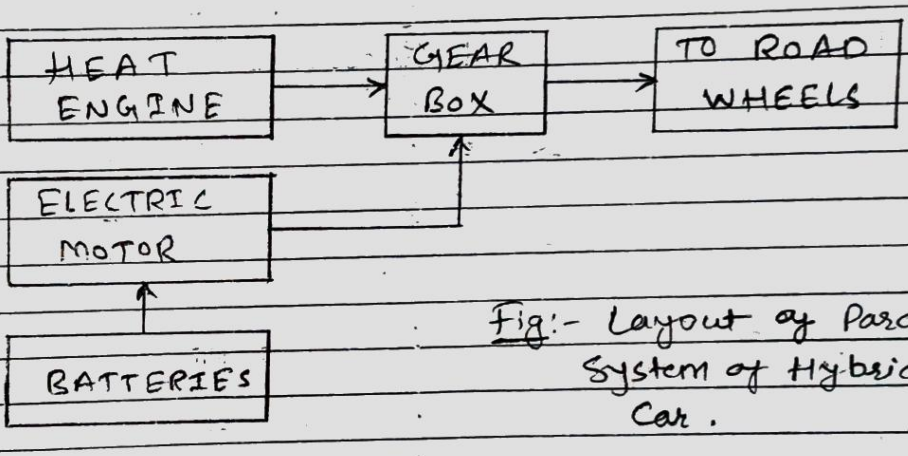

Fig:- Layout of Parallel System of Hybrid Car.

Advantages:-
- Lower emissions & better mileage.
- Smaller engine means less weight
- Cheaper routine maintainance
- Combining best points of electrical energy & IC engines for vehicle propulsion.

Disadvantages:-
- Higher initial cost
- Significant cost of battery pack which has to be replaced every few years.
- More weight due to battery pack.
- Lower acceleration than the cars running on IC engines

Example:- Honda Insight, Toyota Prius.

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Comparison of Specifications of 2-wheelers, LMV & trucks

1. Engine type	- 4 stroke / 2 stroke Petrol	- 4-stroke Petrol or Diesel	- 4 stroke Diesel.
2. Displacement (CC)	- 100-150 cc	- 800 - 2000 cc	- 3000 - 12800 cc
3. Max Power	- 8.3 - 14 bhp	- 47 - 147 bhp	- 105 - 480 bhp
4. Max Torque	- 10.5 - 80.6 Nm	- 69 - 370 Nm	- 284 - 2400 Nm
5. max. RPM	- 6000 - 8500 rpm	- 2200 - 6200 rpm	- 1500 - 2000 rpm
6. Max Speed	- 85 - 150 kmph	- 140 - 240 kmph	- 80 - 100 kmph
7. No of Cylinders	- 1 or 2	- 3, 4 or 6	- 6 - 8
8. Braking System	- Disc or drum	- Disc or drum	- Air brakes
9. Seating Capacity	- 2	- 4 - 7	- 2 (goods carrier) 17-40 (passenger)
10. Gearbox	- 4-5 speed. No reverse gear.	- 4-6 speed with reverse gear	- 4-6 with reverse gear.

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Cost analysis of Vehicle :-

The overall cost of vehicle include many parameters :-

1. Torque :- If the engine torque is more, cost of the vehicle is more. For ex. Maruti 800 cc has less cost than Maruti Baleno due to less torque produced.
2. No. of cylinders :- The engine with more no. of cylinders, is costly than the engine with less cylinders.
3. Types of brakes :- The braking system of a vehicle also adds to the cost. Disc brakes are costly than the drum brakes.
4. Type of engine :- According to the type of engine and it's capacity, cost of vehicle changes. High power engines are costly. Diesel engine has more cost than Petrol due to it's size and capacity.
5. Safety feature :- Advanced safety features like airbags, ABS, etc. increases cost of vehicle.
6. Brand of Vehicle :- It also increases cost as can be seen, Mercedez Benz, Audi, BMW vehicles are costly than Maruti, Tata because these are international brands.
7. Aesthetics :- The looks of a vehicle, painting and aerodynamics etc. increases the cost. A special colour variant has more cost than common colours like White, grey.
8. Insurance, warranty, Toll ; registration ; maintainance costs etc these additional one time or time to time costs also added to the pocket of the owner.

Systems in Mechanical Engineering
Question Bank-SME

Unit III – Vehicles and Their Specifications

1. What are vehicles? Write short note on classification of automobiles.
2. Write the specifications for any type of two wheelers.
3. Write specification for light motor vehicles.
4. Compare the vehicles specifications of two wheeler and fore wheeler.
5. Write comparison of of specifications of light commercial vehicle and heavy commercial vehicle.
6. What are different point to be covered in vehicle specification?
7. Write specifications for mini truck Q8 write specification for any bus.
8. Differentiate between passenger vehicle and transport vehicles with specification.
9. List various components used in IC engine explain any two components with neat sketch.
10. Explain,

    A) CC B) Stroke C) Bore.
11. Explain with neat sketch construction and working of a hybrid vehicles.
12. Explain with neat sketch construction and working of a Electrical vehicles.
13. Write engine specifications of passenger vehicles.
14. Compare engine specifications of two wheelers and four wheelers.
15. Explain the effort of following on cost of the vehicle.
16. A) Torque B) speed C) Number of cylinders D) type of break used
17. Write more on cost analysis of vehicle.

LECTURE SCHEDULE

SYSTEMS IN MECHANICAL ENGINEERING

UNIT – III Vehicles and their Specifications

Sr. No.	Lecture No	Topic Planned Unit I	In side Lecture [Refer Question Bank]	Outside Lecture(Home assignment) [Refer Question Bank]	Remark
21	21	Classification of automobile. Vehicle specifications of two/three wheeler, light motor vehicles.	Q1,Q2	Q3,Q4,Q5	
22	22	Vehicle specifications of trucks, buses and multi-axle vehicles	Q6,Q7	Q8,Q9	
23	23	Engine components (Introduction Only). Study of engine specifications Comparison of specifications of vehicles	Q10,Q11	Q12,Q13	
24	24	Introduction of Electric and Hybriu Vehicles	Q14	Q15	
25	25	Cost analysis of the Vehicle	Q16	Q17	