

**EXCITING WORLD OF
AUTOMOBILES**



STUDENT WORKBOOK

Curriculum : AUTO-SRV L1-NQ²⁰¹²

Unit : AUTO-SRV L1U3

**Major Systems & Components
of an Automobile**

**Vocational Learning Material for Schools
PSS Central Institute of Vocational Education
Bhopal**

PREFACE

Improving the parity of esteem between the general academic education and vocational education, is the policy priority of the Government of India. The National Vocational Education Qualification Framework (NVEQF) developed by the Ministry of Human Resource Development (MHRD), Government of India, is a descriptive framework that provides a common reference for linking various qualifications. It will be used for setting common principles and guidelines for a nationally recognized qualification system covering Schools, Vocational Education and Training Institutions, Technical Education Institutions, Colleges and Universities. The NVEQF will act as a translation device to make qualifications more understandable to employers, students and institutions. It will promote transparency of qualifications and facilitate learner's mobility between different qualifications, thus encouraging lifelong learning. PSSCIVE has taken lead in development of learning material for the Automobile Sector for all level in collaboration with the Automobile Skill Development Corporation (ASDC).

The present material contains activity related to Level L-1 for the Automobile service sector. This will fulfill the needs of the students willing to learn activities relating to the Automobile Service Sector. Any student/ entrepreneur willing to start an Automobile Service Sector can acquire the desired competencies with the help of this book.

The book has been written by experts but reviewed by all the members of the group. I am grateful to the authors for the development of this book and to the members of the Working Group for their candid suggestions, during the development and review. Their names are given elsewhere.

I appreciate efforts put in the by Dr. Saurabh Prakash, as the Project Coordinator of the Working Group in planning and organizing Meetings which led to the final form of this title.

I shall be grateful to receive suggestions and observations from readers, which would help in bringing out a revised and improved version of this book.

Bhopal
June, 2012

Prof. R.B. Shivagunde
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This student workbook was developed, with active involvement of Automobile Skill Development Council (ASDC) keeping in view the National Occupation Standard (NOS) for Service Technician L4 developed by ASDC.

This project for development of the student workbook was coordinated by the PSS Central Institute of Vocational Education, a constituent unit of National Council of Educational Research and Training, which is under Ministry of Human Resource Development, Government of India.

Student Details

Student Name: _____

Student Roll Number: _____

Batch Start Date: _____

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About this Workbook

This workbook is to assist students with completing the Auto Sector **L1U3-NQ2012** unit of competency: **Major Systems & Components of an Automobile**. Students should study the workbook in class or in their own time.

This workbook contains sessions for imparting knowledge & skills on various aspects of the unit. The workbook also includes information, exercises, and assessment activities. The assessment plan has been included in the workbook to assist you in scheduling your time for completing the assignments. Each assessment activity is followed by a checklist for meeting the assessment criteria. The criteria will help you to ensure that you have fulfilled all of the assessment requirements to receive a 'competency' grading/Certification by ASDC.

Unit Information

Unit name: Major Systems & Components of an Automobile

Unit code: Auto L1U3-NQ2012

Unit descriptor:

This unit provides the introductory knowledge & skills covering major components and systems of an automobile. This covers Chassis Frame, Auto Body, Engine, Transmission, Front and Rear Axle, Steering System, Suspension System, Wheels and Tyres, Brakes, Electrical & Electronic Systems, Air Conditioning System , Lubrication System, Cooling System and Active and Passive Systems

Resource implications:

- Notebooks, Pen, Pencil, Eraser, Computer, LCD projector. Sketches, drawing, pictures and poster of various components of an automobile. Animation and videos of various components of vehicle. Sample and cut outs of various components and assembly system of an automobile.

Nominal hours: 60 hours

Elements and Performance Criteria

- Elements define the critical learning outcomes of a unit of competency.
- Performance criteria specify the level of performance required to demonstrate the achievement of the Competency Element.

Element	Performance Criteria
<p>Role of each of the 14 components and system of an automobile as follows</p> <ul style="list-style-type: none"> – Chassis Frame, – Auto Body, – Engine, – Transmission – Lubrication System, – Cooling System – Front and Rear Axle, – Steering System, – Suspension System, – Wheels and Tyres, – Brakes, – Electrical & Electronic Systems, Air Conditioning System and Active and Passive Systems 	<p>1 Able to identify.....</p> <p>2 Able to make drawing, sketch of.....</p> <p>3 Able to describe importance and use of.. (14 components and system of an automobile as follows)</p> <ul style="list-style-type: none"> – Chassis Frame, – Auto Body, – Engine, – Transmission – Lubrication System, – Cooling System – Front and Rear Axle, – Steering System, – Suspension System, – Wheels and Tyres, – Brakes, – Electrical & Electronic Systems, – Air Conditioning System and Active and Passive Systems

Relevant Knowledge and Skills

1. Relevant Knowledge

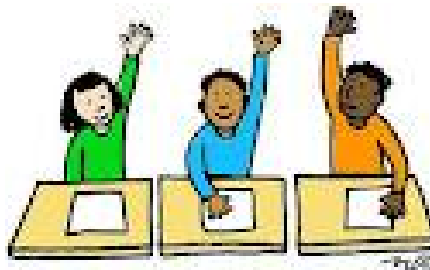
Introduction to various parts & systems like Chassis Frame, Auto Body, Engine, Transmission, Lubrication System, Cooling System Front and Rear Axle, Steering System, Suspension System, Wheels and Tyre, Brakes, Electrical & Electronic Systems, Air Conditioning System and Active and Passive Safety

2. Skills

Ability to Identify & describe various parts & components like Chassis Frame, Auto Body, Engine, Lubrication System, Cooling System, Front and Rear Axle, Steering System, Suspension System, Wheels and Tyres, Brakes, Electrical & Electronic Systems, Air Conditioning System and Active and Passive Safety.

Assessment Plan

Session No.	Assessment method	Due Date	Completion Date
1.	Fill in the Blanks		
2.	Fill in the Blanks		
3.	Fill in the Blanks		



Introduction

By now you are already familiar with an **Automobile**. Automobiles are made up of several components, assemblies and systems. The growing auto industry has given rise to a growing auto component industry also. India has emerged as global outsourcing hub for manufacturing of various automobile components. All major Companies like Toyota, Hyundai, Ford, Volvo, Renault and Daimler Chrysler and others are now sourcing their automotive components from Indian manufacturers.

The auto components industry is predominantly divided into five segments:

- Engine parts
- Drive Transmission & Steering Parts
- Suspension & Brake Parts
- Electrical Parts
- Body and chassis

Global automobile manufacturers see India as a manufacturing hub for auto components due to:

- Low cost labour force and availability of raw material which makes India cost competitive.
- India has an established manufacturing base.
- Major international auto-components including Delphi, Visteon, Bosch and Meritor have set up operations in India.
- Automobile manufacturers and auto component manufacturers have set up International Purchasing Offices (IPOs) in India.
- Fine-quality components are manufactured in India.
- India is a global hub for R&D: GM, Daimler Chrysler, Bosch, Suzuki, Johnson Controls etc. All have their research centre in India.

In this Unit, you will learn about various components and systems that makeup a complete automobile. Therefore you will be introduced to engine and its part, Body and chassis, Drive Transmission & Steering Parts, Suspension & Brake Parts, Electrical Parts and other systems that make it possible for running of an automobile.

Session 1: Chassis Frame and Auto Body

Relevant Knowledge

The Chassis

Chassis is a French term and was initially used to denote the frame or main structure of a vehicle. The chassis contains all the major units necessary to propel the vehicle, guide its motion, stop it, and allow it to run smoothly over uneven surfaces. It is the main mounting for all the components including the body. It is also known as carrying unit.

The chassis includes the following major components:

1. Major part of a chassis is a steel frame.
2. In case of a passenger car the whole body is also an integral part of the chassis. However, in commercial vehicles like trucks & buses the body is not a part of the chassis. Therefore a chassis is almost a complete vehicle except body, other accessories which are not involved in the movement of the vehicle.
3. Other major components like Engine, Transmission system, Front & rear axle, Steering system, Suspension system, Wheels Tires & Brakes.

Functions of the chassis frame

1. To carry the weight of the vehicle and its passengers.
2. To withstand the engine and transmission torque and thrust stresses, as well as accelerating and braking torque.
3. To withstand the centrifugal force while cornering.
4. To withstand the bending loads and twisting due to the rise and fall of the front and rear axles.

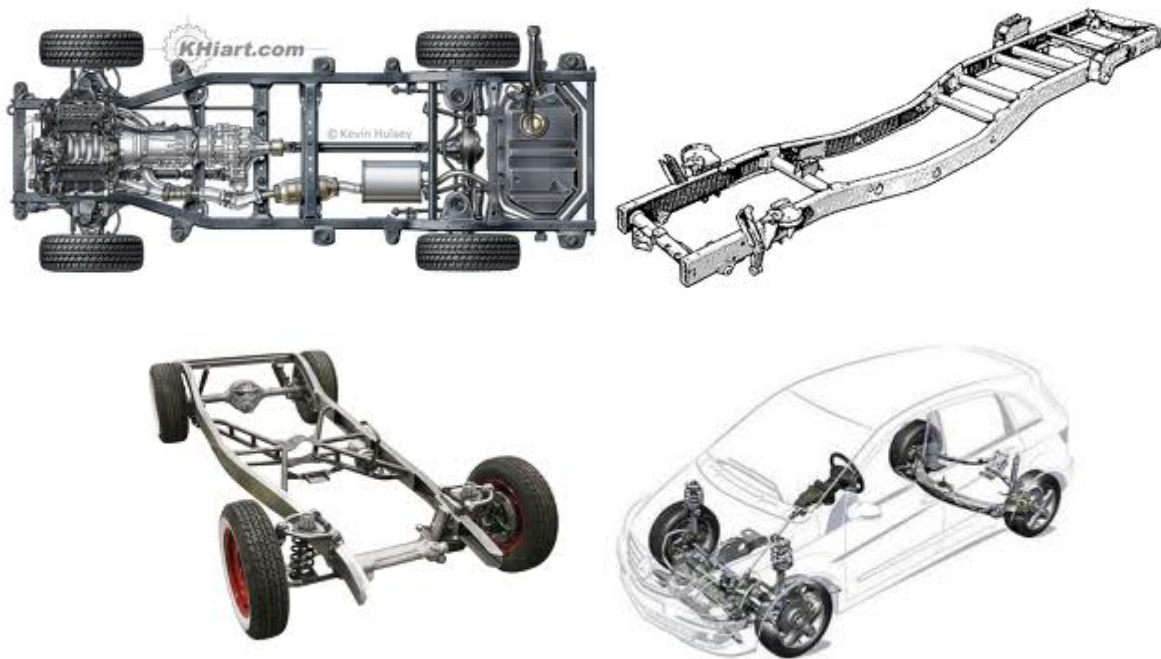


Fig : Diagram of different types of chassis frame

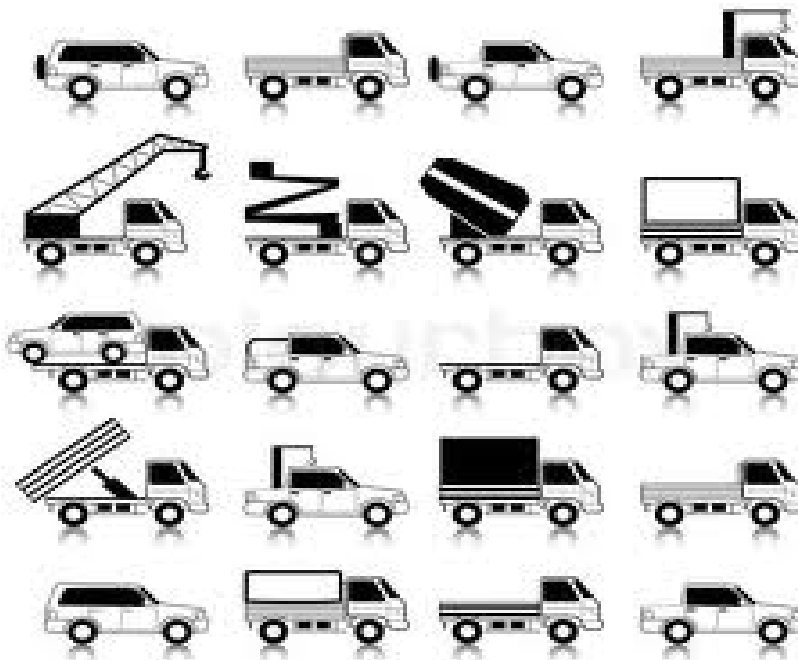


Fig. Different type of automobile body

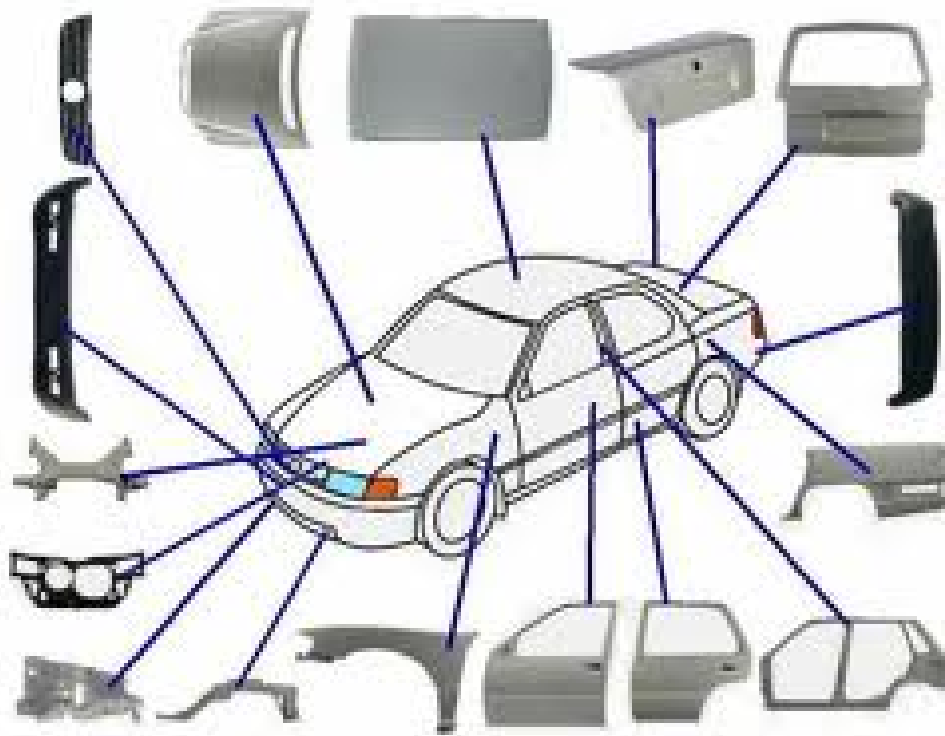


Fig. Parts of the Automobile vehicle



Fig : Frame of the body

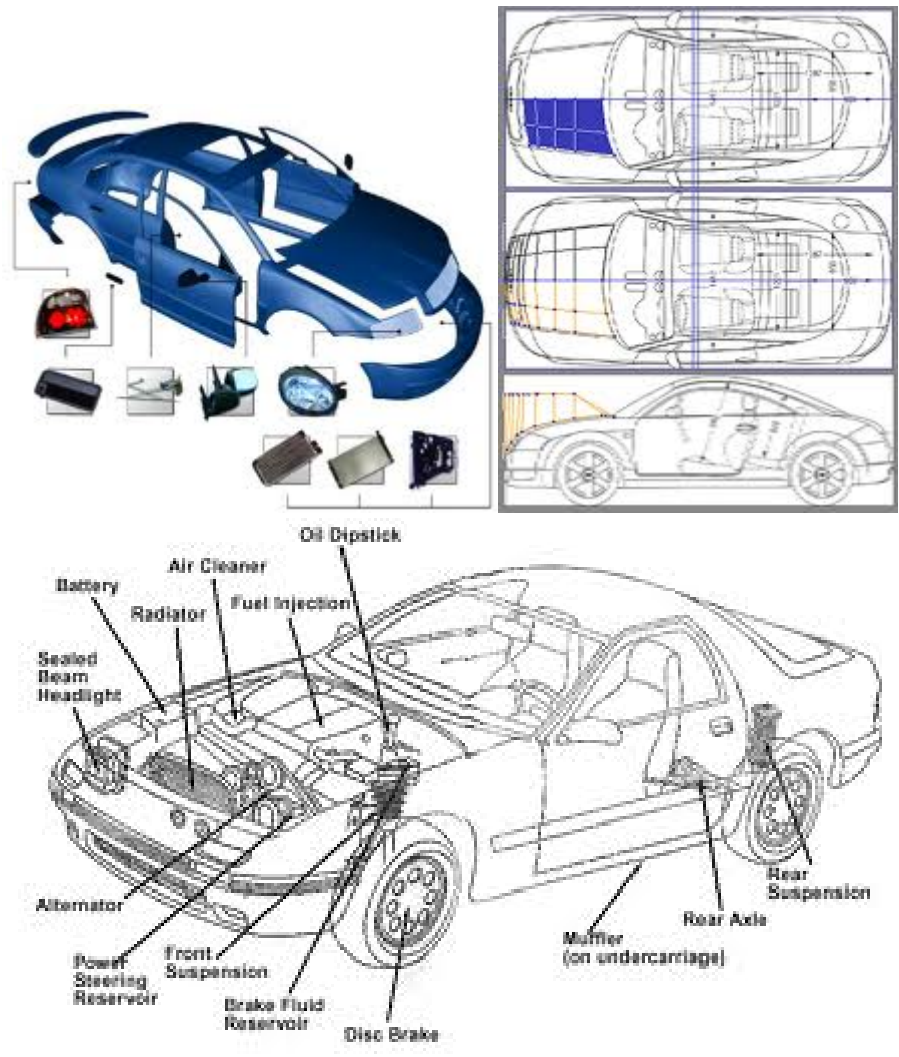


Fig. Components of a Vehicle



Fig : Photograph of a Complete Car

Auto body or superstructure

In case of integral or frameless construction the body is the integral part of chassis frame. But in case of the conventional chassis frame the body or superstructure is made after receiving the chassis from the manufacturer. The shape of the body depends upon the ultimate use for which the vehicle is meant.

Body is made of sheet metal or fiber glass, so that the passengers can sit in it. To make journey comfortable cushioned seats are provided. Body is provided on all sides with glass-panes fixed to protect the passengers from dust and rain. Bus bodies are mostly all metal bodies and can be either of (a) steel section pillars with steel sheet paneling, (b) steel section pillars with aluminum paneling, (c) all aluminum bodies, i.e., pillars, frame work and paneling are all made up of aluminum sections and sheets. This is because aluminum is very light in weight compare to steel. In the truck bodies only the driver's compartment is covered whereas the rest is kept open. Such bodies are usually called load bodies. In most of the cases, it is an open body, whereas for liquid material like water, milk and fuel products a tank is mounted on the chassis. The body is fixed to the chassis with the help of I or U-bolts with rubber packing placed between the chassis and body cross members as shown below :



Fig. U bolt

Requirements of Automobile Body

The body of a motor vehicle should fulfill the following requirements:

1. The body should be light.
2. It should have minimum number of components.
3. It should have long fatigue life.
4. It should have uniformly distributed load.
5. It should provide sufficient space for passengers and luggage.
6. It should have good access to the engine and suspension system.
7. It should create minimum vibrations when the vehicle is running.
8. It should have minimum resistance to air.
9. It should be cheap and easy in manufacturing.
10. It should provide clear all-round vision through glass areas.
11. It should be attractive in shape and colour.

Session 1: Chassis Frame and Auto Body

Exercise: Assignment

1. Name the component of chassis of a vehicle :

S.No.	Name of components
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

2. Observe and identify components of a car in your area and draw their diagrams



Session 1: Chassis Frame and Auto Body

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. A chassis is almost a complete vehicle _____ body,
2. The shape of the body _____ upon the ultimate use for which the vehicle is meant.
3. Major part of a chassis is a _____ frame.
4. In commercial vehicles like trucks & buses the body is not a _____ of the chassis.
5. In most of the cases, it is an open body, whereas for liquid material like water, milk and fuel products a _____ is mounted on the chassis.

Session 1: Chassis Frame and Auto body

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Differentiated between chassis frame and auto body.

Part B

Discussed in class the following:

- Functions of the chassis frame
- Requirements of Automobile Body

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to draw a chassis and auto boy and its parts		

Session 2: Engine and its Components

Relevant Knowledge

Engine

Engine is heart of an automobile. Its role is very important. It converts the Chemical Energy (heat energy) to Mechanical Energy. This energy is utilized for vehicular movement. There are different ways of igniting fuel in an auto engine. Accordingly engines are called Internal Combustion (IC) OR external combustion Engines. Even within the IC engine category ignition can be by a spark or by high compression.



Fig : Engine assembly

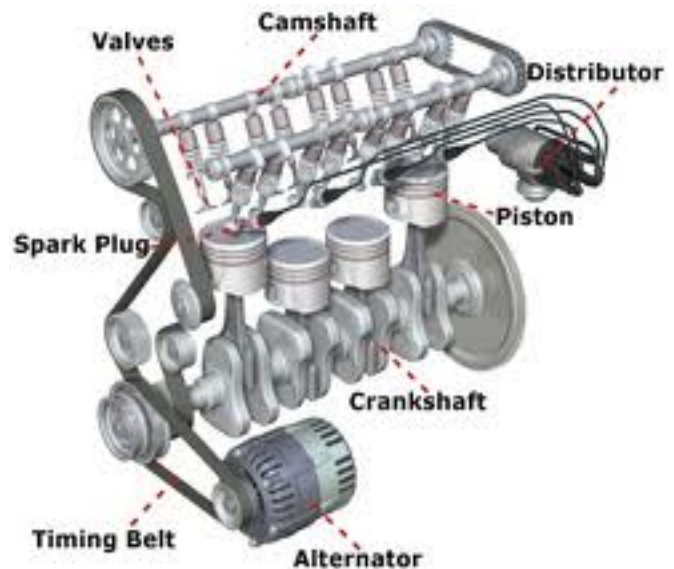


Fig. Some Engine components

Automotive engines are called internal-combustion (IC) engines because the fuel that runs them engine burned internally, or inside the engines. There are two types engines – reciprocating engine and rotary engine.

Reciprocating means moving up and down, or back and forth. Almost all automotive engines are of the reciprocating type. This type of engine is called a piston engine.

Rotary engines have rotors that spin, or rotate. Wankel has invented the Rotary engine, hence it is named as Wankel engine and these are slowly coming up in use today.

There are two kinds of piston engines (IC Engines)

1. Spark-ignition (Petrol or gas) engine
2. Compression ignition (diesel) engine

The differences between these two engines are:

- The type of fuel used
- The way the fuel gets into the engine cylinders
- The way the fuel is ignited

The spark-ignition engine (petrol or gas engine)

The spark-ignition engine uses a highly volatile fuel which turns to vapor easily, such as gasoline or gasohol. The fuel is mixed with air **before** it enters the engine cylinders. The fuel turns into a vapor and mixes with the air to form a combustible air-fuel mixture. This mixture is then enters the cylinders and is compressed. Next, an electric spark

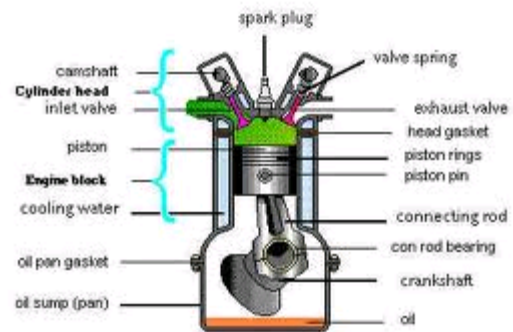


Fig. Ignition System

produced by the ignition system to ignite the combustible mixture, which is already being compressed into the combustion chamber of engine.

The compression-ignition (diesel engine)

In the compression-ignition engine or diesel engine, only fresh air enters the cylinder, which is then compressed to a very high temperature and pressure. The air is compressed so much that its temperature goes up to 1000⁰F (538⁰C) or higher. Then the diesel is injected (sprayed) into the engine cylinder. This spray contains very very fine and tiny cloud of diesel known as atomized form in automobile jargon. The hot air, or heat of compression, ignites the fuel. This is why the diesel engine is called a compression-ignition engine.

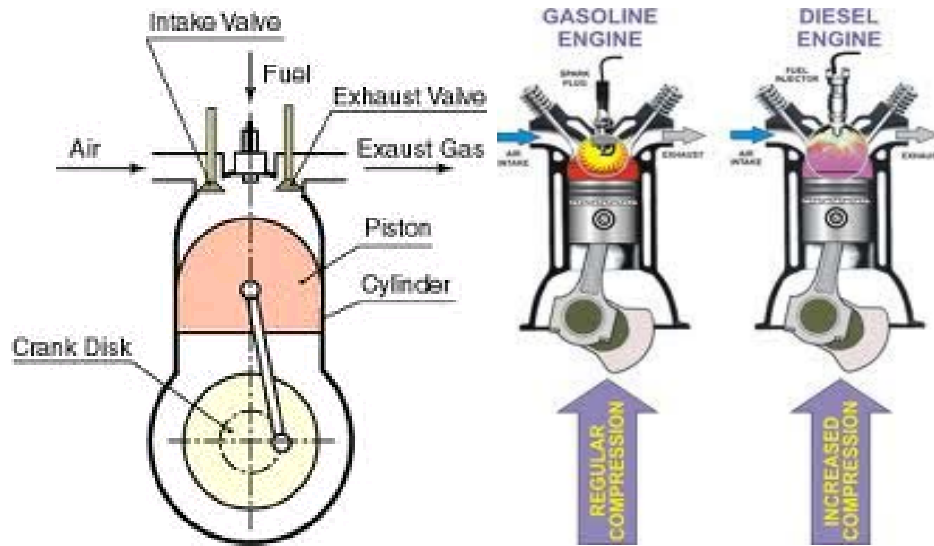


Fig: Ignition System

Components of I.C. engine

- 1. Cylinder.** The cylinder of an I.C. engine is considered as the main body of the engine in which piston reciprocates to develop power. It has to withstand very high pressures (about 70 bar) and temperatures (about 2200⁰C) because there is direct combustion inside the cylinder. Therefore, its material should be such that it can retain strength at high temperatures, should be good conductor of heat and should resist to rapid wear and tear due to reciprocating parts. Generally, ordinary cast iron is used, but in case of heavy duty engines, alloy steels or aluminum alloy are used.
- 2. Cylinder head.** The cylinder head closes one end of the cylinder. It houses the inlet and exhaust valves. The charge (fuel and air mixture for SI engine and only air for CI engine) enters through inlet valves and after producing power the exhaust gases escapes through the exhaust valves to the atmosphere.

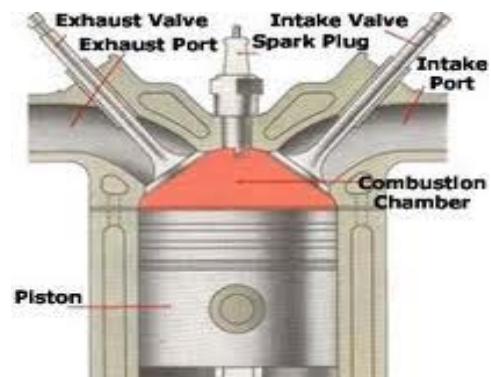


Fig.: Cylinder

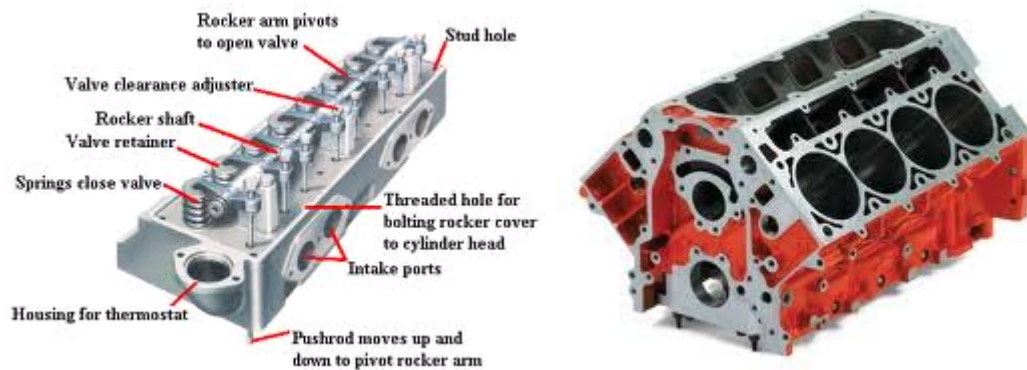


Fig : Cylinder Head Block

Cylinder head is usually cast as one piece and bolted to the top of the cylinder (engine block). A copper and asbestos gaskets are provided between the cylinder and cylinder-head to obtain a gas-tight joint. The material used for the cylinder-head is also cast iron or aluminum alloy.

- Piston and Piston Rings.** Piston is the heart of the engine. The functions of the piston are to compress the charge during compression stroke and to transmit the gas force to the connecting rod and then to the crank during power stroke. The pistons of I.C. engines are usually made of cast iron, cast steel and aluminum alloy. The aluminum alloy has the advantage of higher thermal conductivity and lower specific gravity.

The piston rings are housed in the circumferential grooves provided on the outer surface of the piston. It gives gastight fitting between the piston and the cylinder and prevents the leakage of high pressure gases. These are made of special grade cast iron. This material retains its elastic property at very high temperature. The upper piston rings are called the compression rings and the lower piston rings are called the oiling or oil control rings.

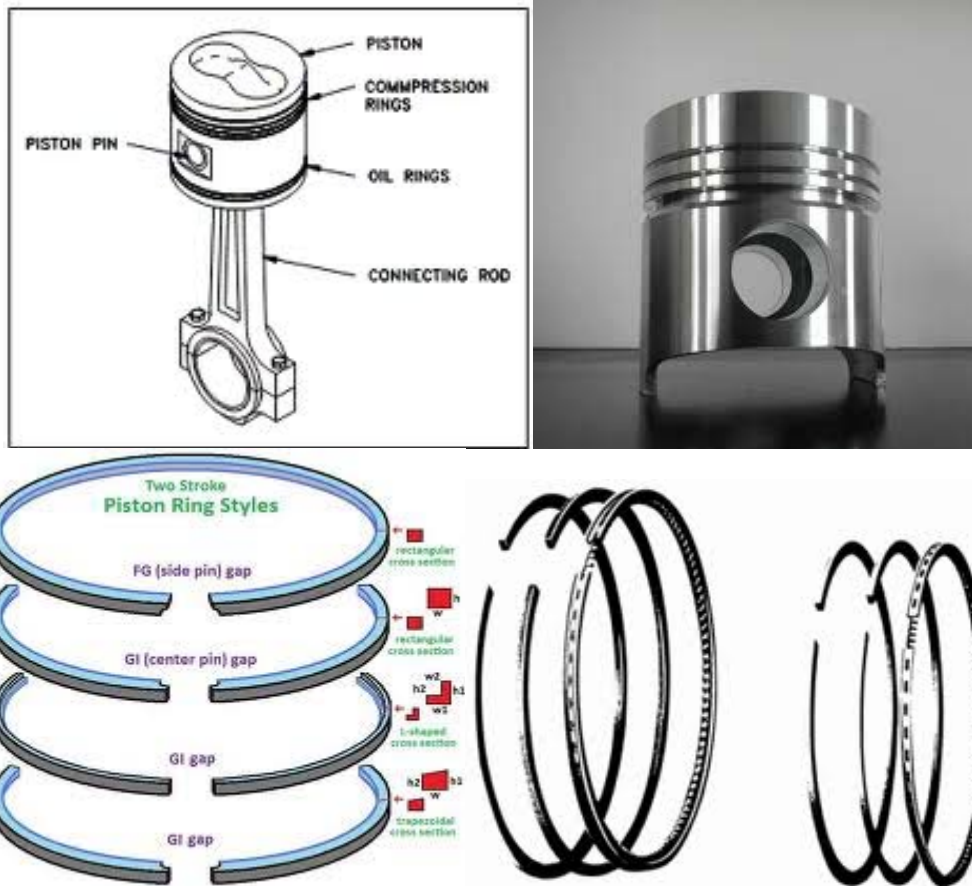


Fig: Piston Ring

4. **Connecting Rod.** It is usually a steel forging of circular, rectangular, I,T, or H section and is highly polished for increased strength. Its small end forms a hinge and pin joint with the piston and its big end is connected to the crank by crank pin. It has a passage for the transfer of lubricating oil from the big end bearing to small end bearing (gudgeon pin).

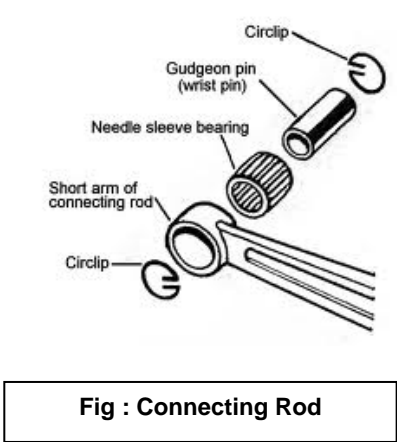


Fig : Connecting Rod



Fig : Connecting Rod

5. **Crank and Crankshaft.** Both crank and crankshaft are steel forged and machined to a smooth finish. The two are held together by means of a key. Crankshaft is supported in main bearings and has a heavy wheel, called flywheel, to even out the fluctuations of torque. The power required for any useful purpose is taken from crankshaft only. The crankshaft is the backbone of the engine.

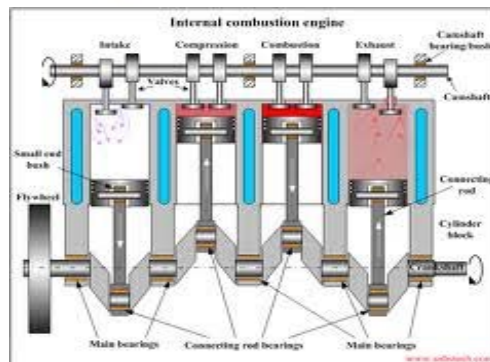
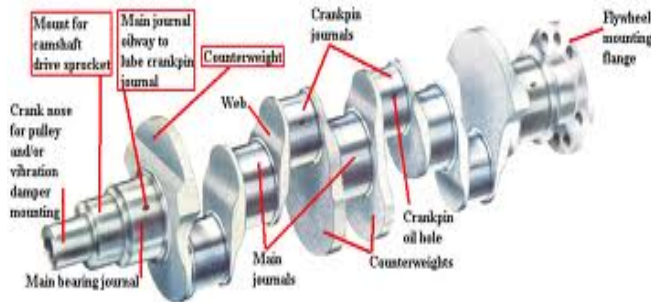


Fig: Crankshaft of multi cylinder engine

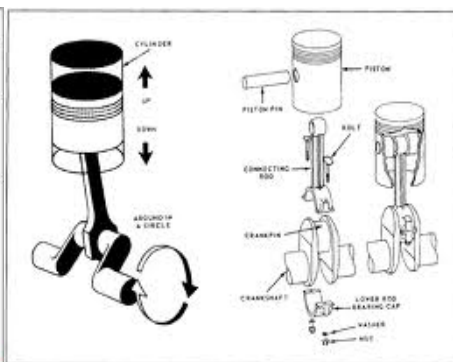


Fig: Crankshaft of single cylinder engine

6. **Piston Pin or Wrist Pin.** The piston pin provides the bearing for the oscillating small end of the connecting rod.

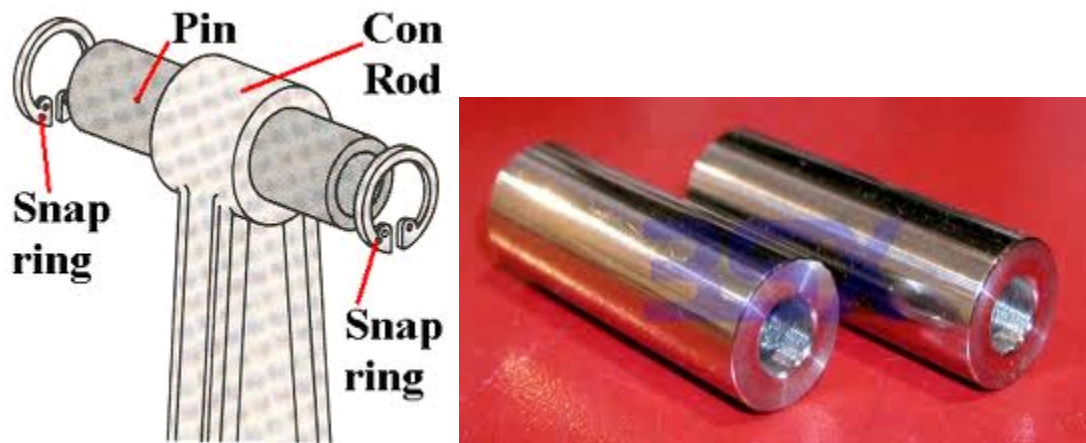


Fig : Piston Pin or Wrist Pin

7. **Inlet Valve :** This valve controls the admission of the charge into the petrol engine or air into diesel engine during suction stroke of the engine.

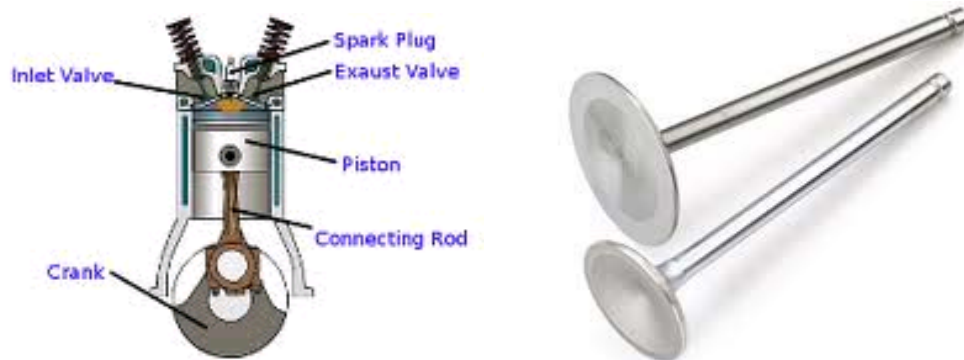


Fig : Inlet Valve

8. **Exhaust Valve.** The removal of exhaust gases after doing work on the piston, is controlled by this valve.
9. **Valve Spring.** The valves are kept closed by the valve springs.



Fig: Valve Spring

10. **Inlet Manifold** : It is the passage which carries the charge from carburetor to the petrol engine or only air to the diesel engine.



Fig : Inlet Manifold

11. **Exhaust Manifold**. It is the passage which carries the exhaust gases from the exhaust valve to the atmosphere.

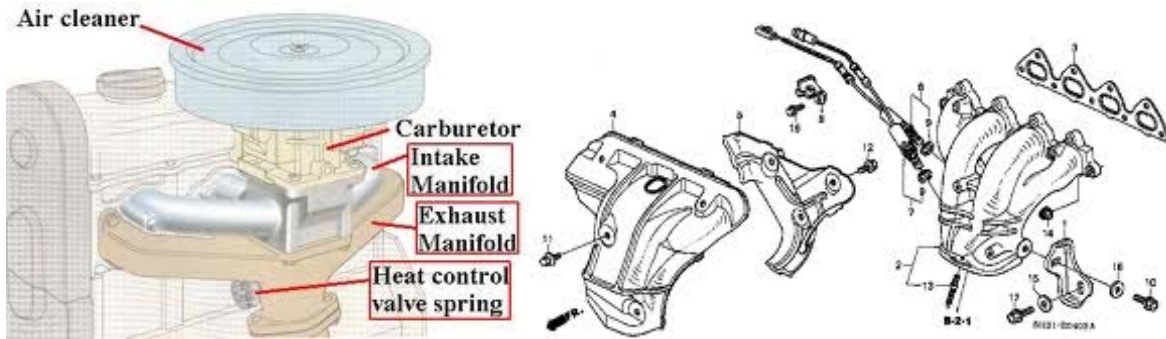


Fig : Exhaust Manifold

12. **Camshaft.** The function of the cam shaft is to operate the intake and exhaust valves through the cams, cam followers, push rods and rocker arms. The cam shaft is driven positively from the crankshaft at half the speed of the crankshaft.



Fig : Camshaft

13. **Cam and Cam follower.** It is made of a required profile to give desired motion to the valve through the follower.

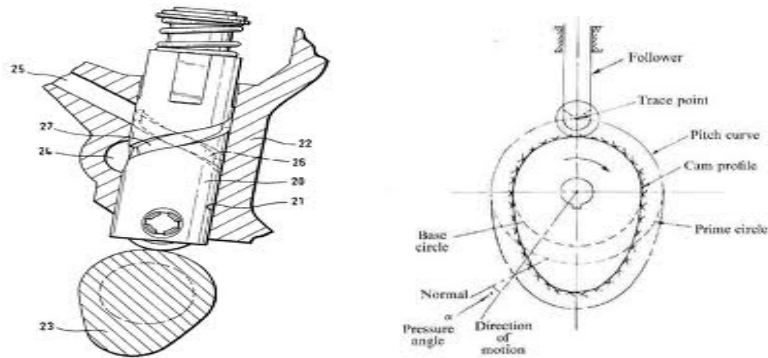


Fig : Cam and Cam follower

14. **Push Rod and Rocker Arm.** The motion of the cam is transmitted to the valve through the push rod and rocker arm. These links together are also known as valve gear.

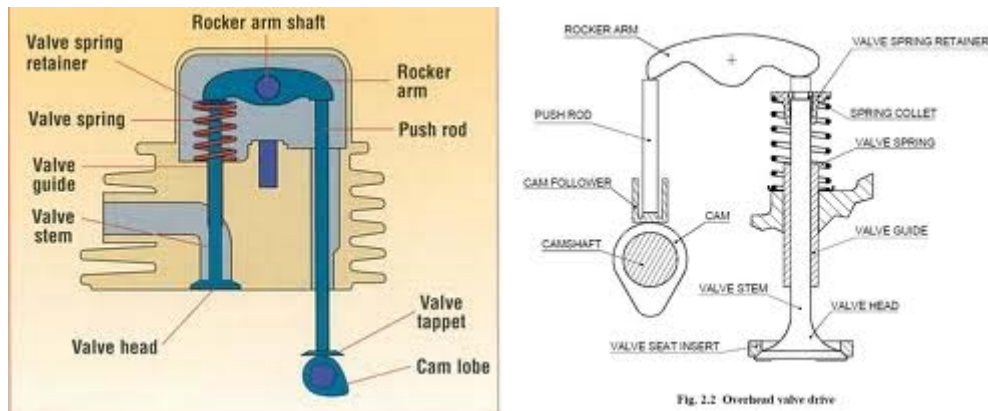


Fig : Push Rod and Rocker Arm

15. **Crank case.** It is the base which holds the cylinder and crankshaft. It also serves as the sump for the lubricating oil.

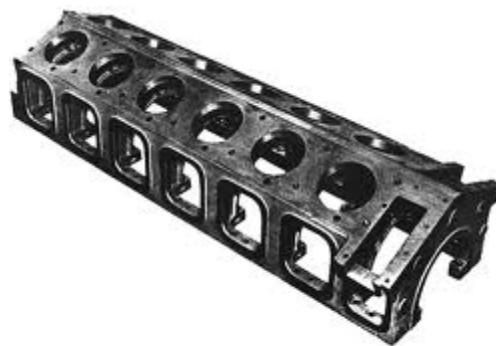


Figure 8
Frame

Fig : Crank Case

16. **Water pump and Water Jacket.** The function of water pump is to draw water from the radiator and supply it to water jacket at certain pressure for the purpose of proper circulation of coolant between engine water jacket and radiator. The jackets are provided in the crankcase (cylinder block) for the circulation of coolant to carry away the excessive heat of the engine.

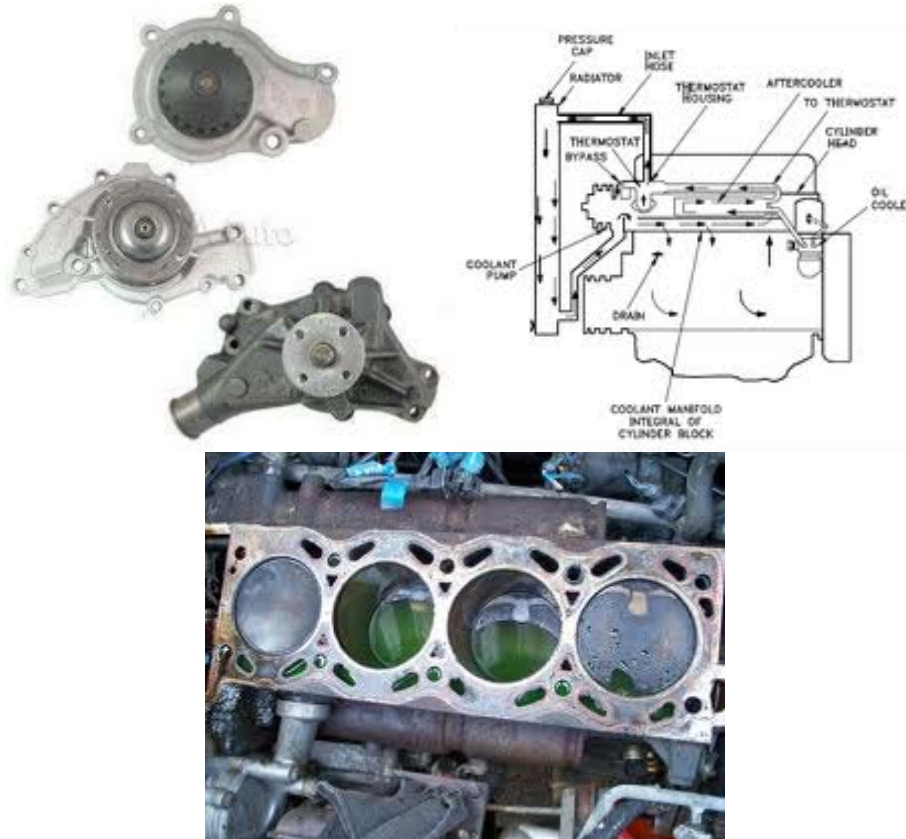


Fig : Water pump and Water Jacket

17. **Radiator:** It has two tanks located at top and bottom. It is the storage of coolant for cooling the engine. It has a pressure cap to increase the boiling point of coolant.



Fig : Radiator

18. **Bed Plate.** The lower portion of the crank case is known as bed-plate. The bed plates are held by the bed bolts to concrete foundations.
19. **Flywheel.** It is a wheel mounted on the crankshaft which stores the energy during the power stroke and transmits the energy through transmission to the wheels when the clutch is engaged.



Fig: Fly Wheel

20. **Governor.** It is run by drive from the crankshaft. The function of the governor is to regulate the charge in case of petrol engine and amount of fuel in case of Diesel engine to maintain the speed of the engine constant, when the load requirement varies.

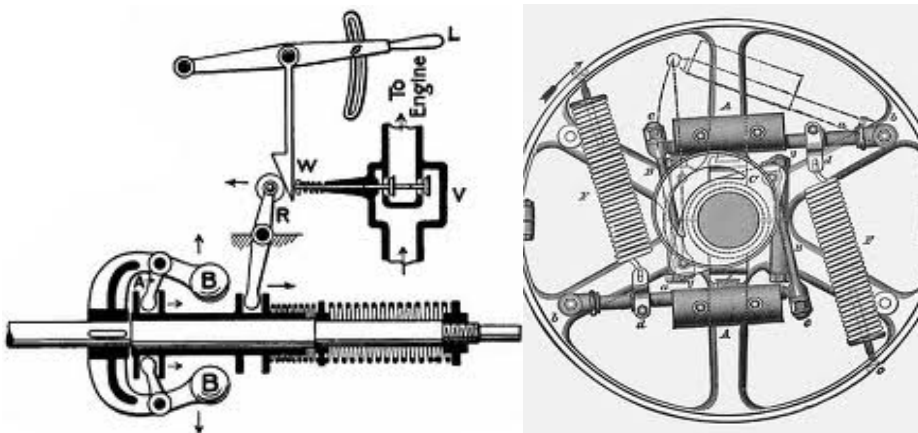


Fig : Governor

The components described above are commonly used for all types of IC engine. Here we are describing only few components which are used in a particular types of engines.

21. **Carburetor:** The function of the carburetor is to supply the uniform air-fuel to the cylinder of a **petrol engine** through the intake manifold. The mass of the mixture entering the cylinder is controlled by a special valve called as **throttle valve** will be described in later sessions.

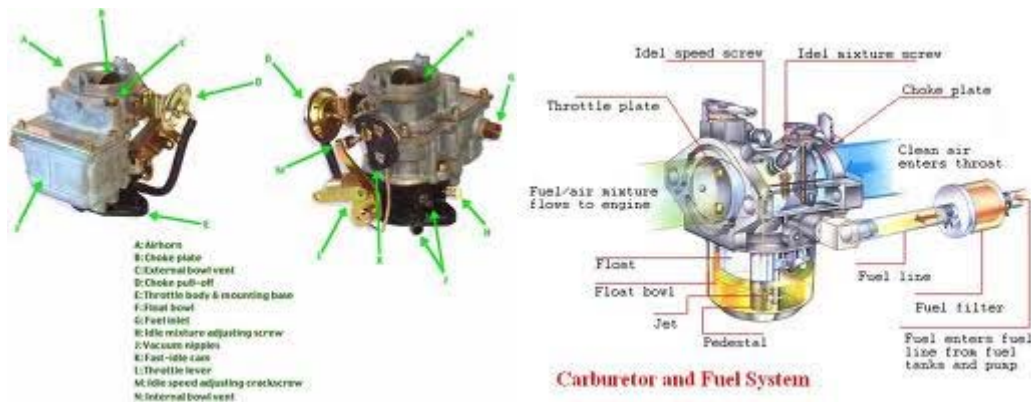


Fig : Carburetor

22. **Spark Plug.** The function of the spark plug is to ignite the mixture after completing the compression in the petrol engine. It is generally mounted in the cylinder head. This is only used in petrol engine.

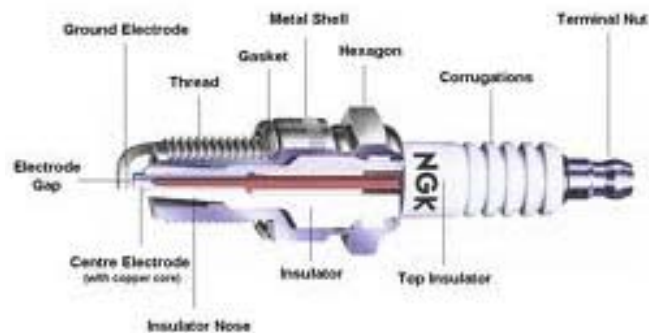


Fig : Spark Plug

23. Fuel Injection Pump. It forces the fuel oil at high pressure in atomized condition through fuel nozzle into the cylinder at the end of compression stroke in diesel engine.

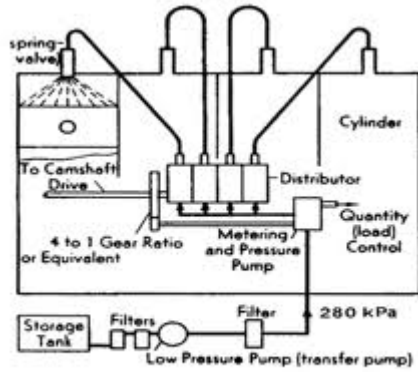


Figure 18
Distributor System



Fig : Fuel Injection Pump

24. Fuel Injector. The function of fuel injector is to break up the oil into fine spray (atomized condition) as it enters the cylinder of diesel engine.

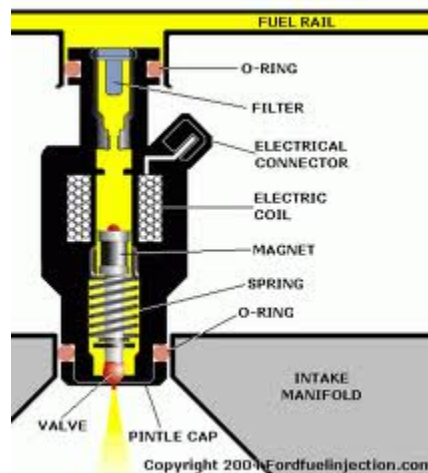


Fig : Fuel Injector

NOTE: Now a days fuel injectors are also used in spark ignition engine (in the inlet manifold) to spray petrol or gasoline in case of MPFI engines (all modern petrol engines).

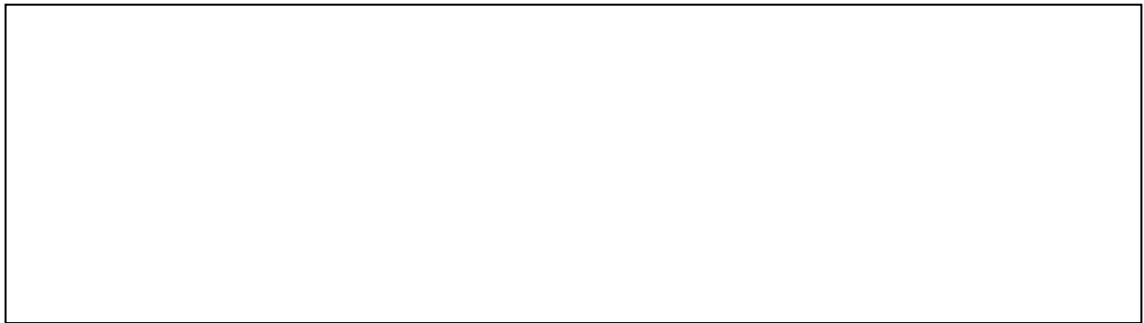
Session 2: Engine and its component

Exercise: Assignment

1. Name the auto component system used in a vehicle:

S.No.	Name of system
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

3. Observe and identify engine in a workshop and draw their diagrams



Session 2: Engine and its component

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Engine is _____ of an automobile. Its role is very important.
2. Engine _____ the Chemical Energy (heat energy) to Mechanical Energy

3. Major _____ parts _____ of _____ engine are _____, _____, _____, _____.
4. The function of the carburetor is to supply the uniform _____ to the cylinder of a _____ through the intake manifold.
5. Sparkplug is _____ used for _____
6. _____ It is a wheel mounted on the crankshaft which stores the energy

Session 2: Engine and its component

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Different components of an engine.

Part B

Discussed in class the following:

- Role of different components of an engine
- Water pump and Water Jacket.
- Role of governor and carburetor

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to draw engine and label its parts		

Session 3: Lubrication System

Relevant Knowledge

As you know that our body requires fluids like water and also oil in the form of fats like ghee, butter, cooking oil for maintenance of our system. Similarly lubrication is required for maintenance of engine. Lubrication circuit is one of the most important ones in the engine. The engine cannot run smoothly for more than a few minutes without the lubricating oil.

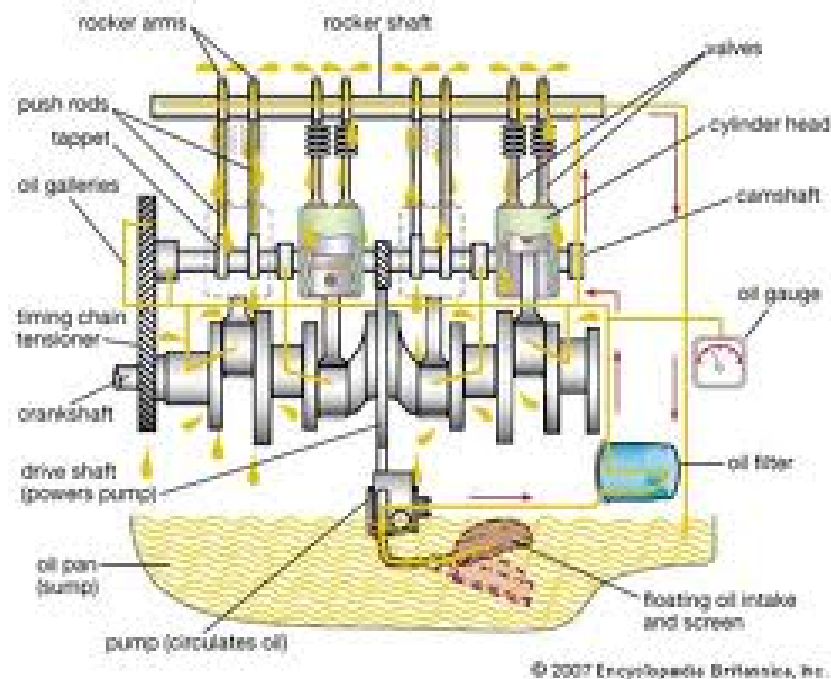


Fig: Lubrication system of the engine.

Whenever two metallic surfaces move over each other under direct contact, dry or solid friction is produced. This is due to the irregularities on the two surfaces interlocking each other. The dry friction thus created produces a lot of heat and results in wear of the metal surface.

Objective of Lubrication

The primary objective of lubrication are:

1. To reduce friction between moving parts to its minimum value so that power loss is minimized.
2. To reduce wear of the moving parts as far as possible.

Apart from these primary objectives, lubrication also serves other important purposes, which may be called secondary. These are as follows:

1. **To provide cooling effect** – The lubricating oil takes heat from the hot moving parts during its circulation and delivers it to the surrounding air through the crank case.
2. **To provide cushioning effect** – The lubricating oil serves also as a good cushion against the shocks experienced by the engine. For example, instant combustion of the fuel in the combustion chamber produces a sudden pressure rise in the cylinder and the shock goes to the bearings through the piston, gudgeon pin and the connecting rod. This shock is then absorbed by the layer of oil present in the main bearings.
3. **To provide cleaning action** – The lubricating oil serves another useful purpose in providing a cleaning action. During its circulation it carries away many impurities, e.g. carbon particles.
4. **To provide a sealing action** – The lubricating oil also helps the piston rings to maintain an effective seal against the high pressure gases in the cylinder from leaking out toward the crank case side.

Other than engine, lubricants are used for protecting following components also:

- Gear box
- Differential
- Steering gear box
- In different joints grease is used as lubricant.

Session 3: Lubrication system

Exercise: Assignment

1. List the important function of lubrication:

S. No.	Functions of lubrication
1	
2	
3	
4	
5	

2. Observe and draw their diagram of lubrication system



Session 3: Lubrication System

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Dry or solid frictions is produced in _____
2. Dry friction creates lot of _____.
3. Objective of lubrication is to reduce _____
4. Lubrication provides _____ effect and _____ effect.

Session 3: Lubrication System

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Importance of lubrication.

Part B

Discussed in class the following:

- Importance of lubrication in engine.
- Lubrications are used for various purpose.
- Lubrication is an essential component.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to draw figure of lubrication system of engine		
Able to identify components of lubrication system of engine		

Session 4: Cooling System

Relevant Knowledge

Cooling System: As our body requires air and water for cooling our system similarly engine also requires cooling. The cooling system has three primary functions. These functions are as follows:

1. Remove excess heat from the engine.
2. Maintain a constant engine operating temperature.
3. Increase the temperature of a cold engine as quickly as possible by maintaining the thermostat valve in closed position which is fitted in the path of coolant circulation.

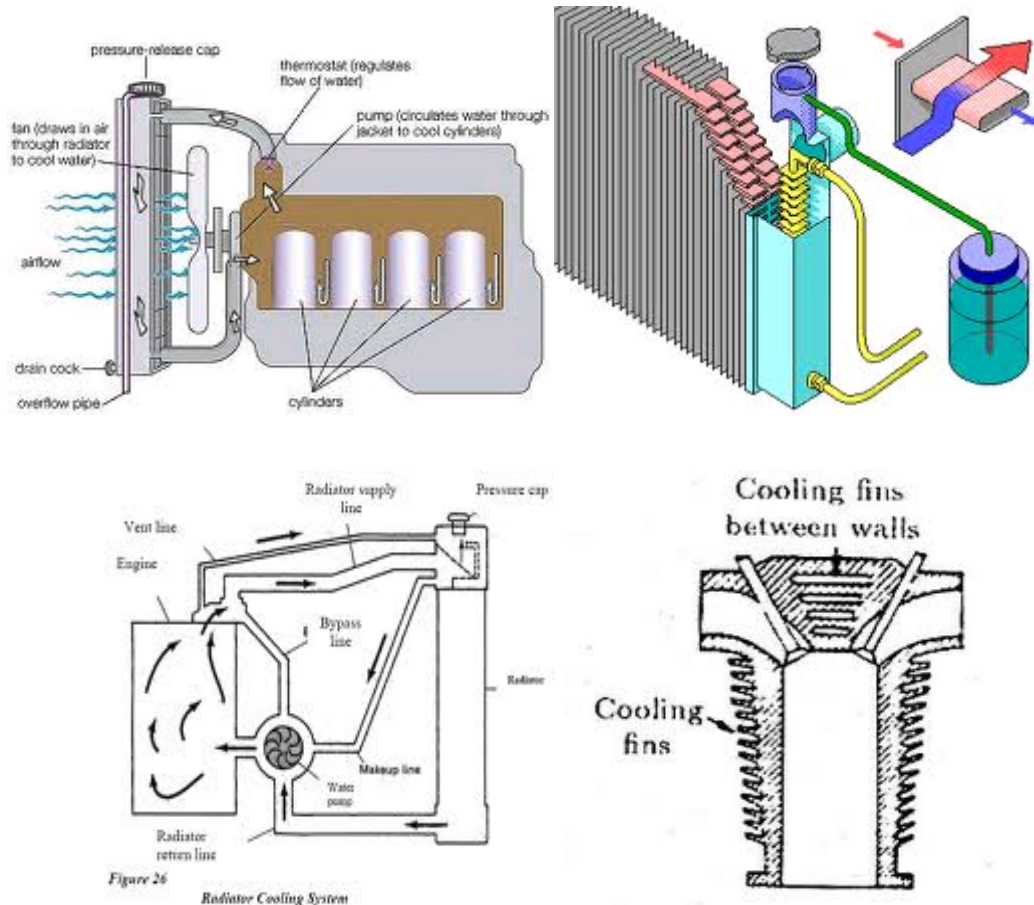


Fig: Cooling of Engine

Necessity of Cooling

The cylinders of internal-combustion engines require cooling because of the inability of the engine to convert all of the heat energy released by combustion into useful work. Liquid cooling is employed in most IC engines, whether the engines are for use in automobiles or elsewhere. The water (coolant) is circulated around the cylinders to pick up heat and then through a radiator to dissipate the heat. Usually a thermostat is located in the circulating system to maintain the design jacket temperature – 71⁰C to 82⁰C. The cooling system is usually pressurized to raise the boiling point of the coolant with the help of a pressure radiator cap which increase the heat transfer capacity of the radiator.

Session 4: Cooling System

Exercise: Assignment

1. List the important function of cooling system:

S.No.	Functions of Cooling
1	
2	
3	
4	
5	

2. Observe and draw the diagram of cooling system



Session 4: Cooling System

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Cooling system remove excess _____ from the engine.
2. Cooling _____ a constant engine operating temperature
3. Objective of cooling is to reduce _____
4. Liquid cooling is employed in most _____ engines.

Session 4: Cooling System

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Importance of cooling system.

Part B

Discussed in class the following:

- Importance of Cooling in engine.
- Coolants are used for a purpose.
- Cooling system is an essential component.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to draw figure on cooling system of engine		
Able to identify the components of cooling system of engine		

Session 5: Fuel Supply System

Relevant Knowledge

Fuel Supply System

In petrol engines, the air and fuel is mixed outside the engine and partly evaporated mixture is supplied to the engine. The fuels such as petrol, benzol and alcohol used in S.I. engine, vaporizes easily if injected in the flow of air, therefore, the engine suction is sufficient to draw the mixture easily in to the cylinder.

The oil fuels which are used in C.I. engines do not vaporize easily. Therefore, a separate injection system is used consists of fuel injection pump (FIP) and injectors.

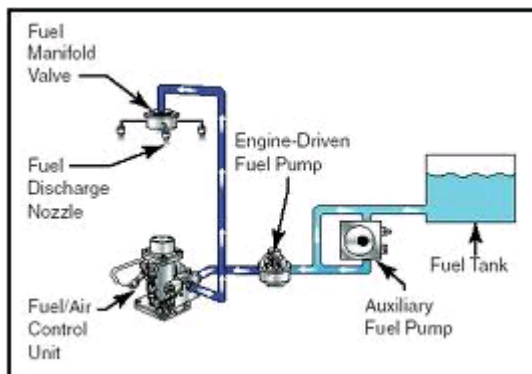


Fig: Fuel supply system for electronic injection

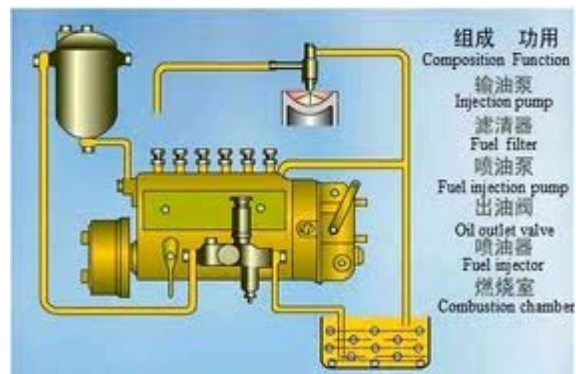


Fig: Conventional Fuel supply system for diesel engine

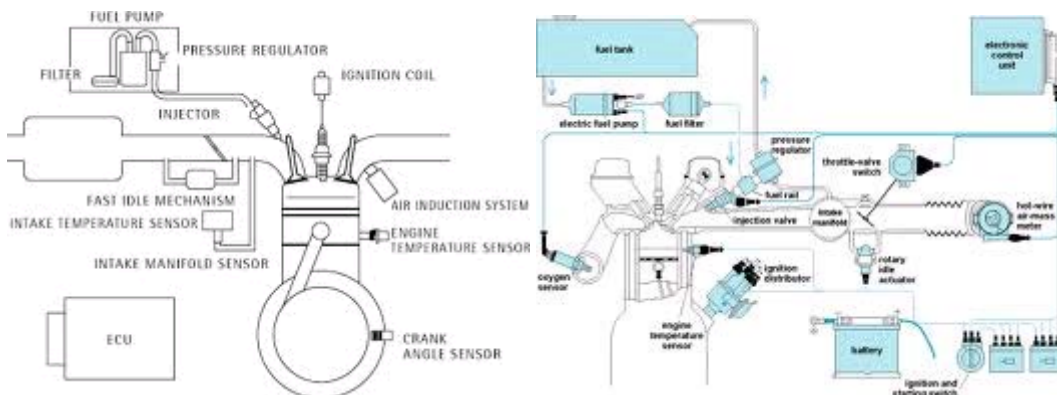


Fig: Fuel System

FUEL SUPPLY COMPONENTS FOR S.I. ENGINE	FUEL SUPPLY COMPONENTS FOR C.I. ENGINE
<ul style="list-style-type: none"> • Fuel tank • Fuel lines • Fuel pump (A.C. mechanical type or electrical type) • Fuel filter • Carburettor • Inlate manifold • Air cleaner <p>Note: In case of modern MPFI engines carburetor is replaced by injectors and sensor.</p>	<ul style="list-style-type: none"> • Fuel tank • Fuel lines • Fuel feed pump (Mechanical type or electrical type) • Fuel filters • Fuel injection pump (FIP) • Fuel injectors

Session 5: Fuel Supply System

Exercise: Assignment

1. List the important function of fuel supply system:

S.No.	Functions of fuel supply system
1	
2	
3	
4	
5	

2. . Observe and draw the diagram of fuel supply system

Session 5: Fuel Supply System

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Air and fuel is _____ outside the engine and partly evaporated _____ is supplied to the engine.
2. The fuels such as petrol, benzol and alcohol used in _____ engine,
3. Suction is sufficient to draw the _____ in to the cylinder.
4. Oil fuels which are used in C.I. engines do not _____ vaporize easily.
5. Injection system used consists of fuel injection pump (FIP) and _____.

Session 5: Fuel Supply System

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Importance of fuel supply system.

Part B

Discussed in class the following:

- Importance of fuel supply in engine.
- Fuels are used for a purpose.
- Fuel supply system is an essential component.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to draw figure on fuel supply system of engine		
Able to list the components of fuel supply system of engine		

Session 6: Transmission System

Relevant Knowledge

Transmission system is used in motor vehicles, where the transmission systems supply the output of the internal combustion engine to the drive wheels. The transmission reduces the higher engine speed to the slower wheel speed, increasing torque in the process. Transmissions are also used on pedal bicycles, fixed machines, and anywhere else rotational speed and torque needs to be adapted.

Transmission System

The transmission system consists of following components.

1. Clutch assembly
2. Gear box assembly (transmission case assembly)
3. Propeller shaft

Clutch assembly

Clutch is a mechanism which enables the rotary motion of one shaft to be transmitted, when desired. The axis of driving shaft and driven shaft are coincident.

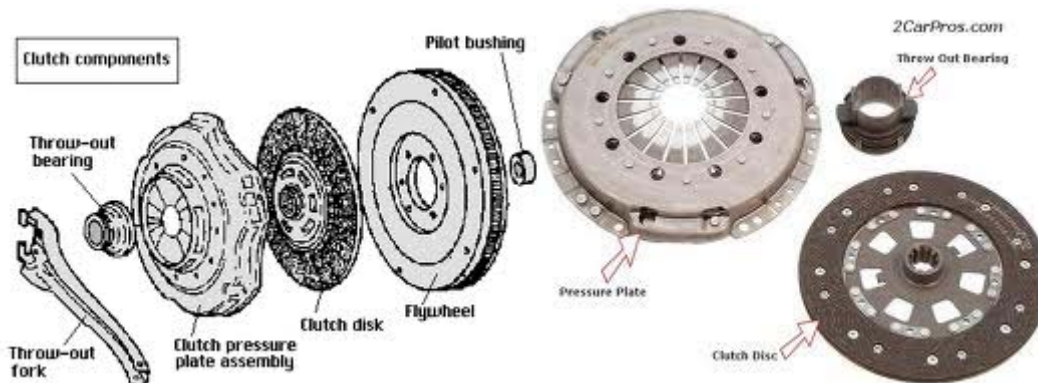


Fig : Different parts of Clutch Assembly

Function of a clutch

1. To disconnect the engine power from the gear box as required under following circumstances.
 - (a) To start the engine and warm it up.
 - (b) To facilitate to engage 1st and 2nd gear to start the vehicle from rest.
 - (c) To facilitate to change the gear as required.
 - (d) Disconnecting drive from the engine to stop the vehicle after application of brakes.
2. Allow the engine to take up load gradually without shock or jerk.

Requirements of a Clutch

1. **Torque transmission.** The clutch should be able to transmit maximum torque of the engine.
2. **Gradual engagement.** The clutch should engage gradually to avoid sudden jerks.
3. **Heat dissipation.** The clutch should be able to dissipate large amount of heat which is generated during the clutch operation due to friction.
4. **Dynamic balancing.** The clutch should be dynamically balanced. This particularly required in the case of high speed engine clutches.
5. **Vibration damping.** The clutch should have suitable mechanism to damp vibrations to eliminate noise produced during the power transmission.
6. **Size.** The clutch size should be as small as possible so that it will occupy minimum space.
7. **Free pedal play.** The clutch should have free pedal play in order to reduce effective load on the carbon thrust bearing and its wear.
8. **Easy in operation.** The clutch should be easy to operate requiring as little exertion as possible on the part of the driver.
9. **Lightness.** The driven member of the clutch should be made as light as possible so that it will not continue to rotate for any length of time after the clutch has been disengaged.

Main Parts of a Clutch

The main parts of clutch are divided into three groups:

1. **Driving members.** The driving members consist of a flywheel mounted on the engine crankshaft. The flywheel is bolted to a cover which carries a pressure plate or driving disc, pressure springs and releasing levers. Thus the entire assembly of the flywheel and the cover rotate all the times. The clutch housing and the cover provided with openings, dissipate the heat generated by the friction during the clutch operation.
2. **Driven members.** The driven member consists of a disc or plate, called the clutch plate. It is free to slide lengthwise on the splines of the clutch shaft (primary shaft). It carries friction materials on both of its surfaces. When it is gripped between the flywheel and the pressure plate, it rotates the clutch shaft through the splines.
3. **Operating members.** The operating members consist of a foot pedal, linkage, release bearing, release levers and the springs.

Gear Box (Transmission Case) Assembly

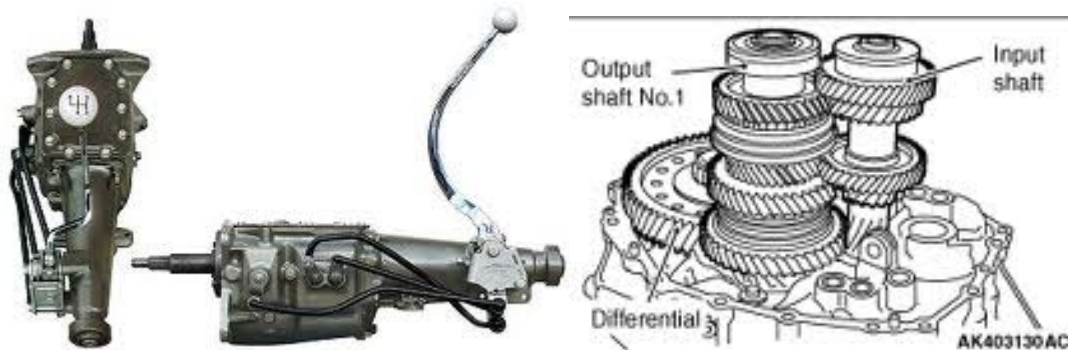


Fig : Gear Box and Gear

We need different gear ratios in the gear box or transmission system to enable the vehicle move in different speed. At the time of starting the vehicle, maximum amount of torque available on the fly wheel, for which low gear ratio has to be selected for the movement of the vehicle. As the engine speed increases the amount of torque is reduced in the fly wheel and it is required to select higher gear ratio.

Function:

1. The main purpose of the gear box is to provide a means to vary the leverage or torque ratio between the engine and the road wheels as required.
2. The transmission also provides a neutral position so that the engine and the road wheels are disconnected even with the clutch in the engaged position.
3. A means to reverse the car by selecting the reverse gear.

Session 6: Transmission System

1. Make a list of parts of clutch assembly used in the vehicle.

S.No.	List of parts of clutch
1.	
2.	
3.	
4.	
5.	

2. Draw the photograph of clutch of a vehicle.



Session 6: Transmission System

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Transmission system is used for _____.
2. Main parts of clutch are _____, _____ and _____
3. Different gear ratios in the _____ to enable the vehicle move in different speed
4. Clutch main parts are _____, _____ and Operating members

Session 6: Transmission System

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Discuss the role of transmission system.

Part B

Discussed in class the following:

- Why transmission is necessary ?
- Role of clutch in transmission system.
- Function of gear box
- Transmission system and its component

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain transmission system		
Able to identify the components of transmission system		

Session 7: Front and Rear Axle

Relevant Knowledge

For movement of a body of a car we need axle and steering system which transmit power to the wheel.

Propeller Shaft

This is the hollow tubular shaft which transmits the drive from the gear box to the bevel pinion of final drive. It consists mainly of three parts:

1. Shaft- As this has to withstand mainly torsional loads, it is usually made of tubular cross section. It also has to be dynamically balanced.
2. One or two universal joints, depending upon the type of rear axle drive used. The universal joints account for the up and down movements of the rear axle when the vehicle is running.
3. Slip joint- Depending upon the type of drive, one slip joint may be there in shaft. This serves to adjust the length of the propeller shaft when demanded by the rear axle movements.

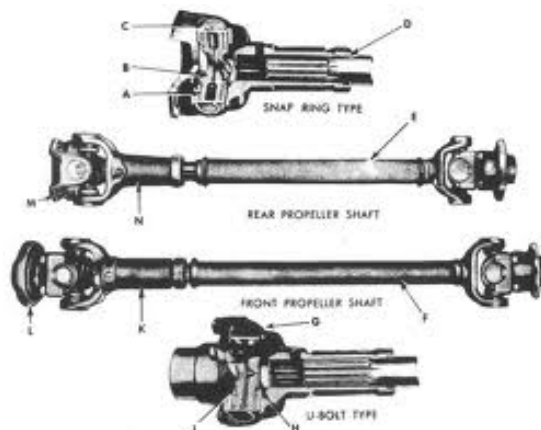


Fig : Propeller Shaft and Universal Joint

Front and Rear Axle

Front Axle

Front axle is usually a drop forging of steel. The axle has to take bending loads due to load of the vehicle and also torque loads due to braking of the wheels. For this reason, front axle is made of I-section in the central portion, while the ends are made either circular or elliptical.



Fig: Front Axle

A downward sweep is given to the centre portion to keep a low chassis height. Both the end of front axle are mounted with **stub axles with the help of king pin**. The front road wheels are mounted on stub axles.

Rear Axle

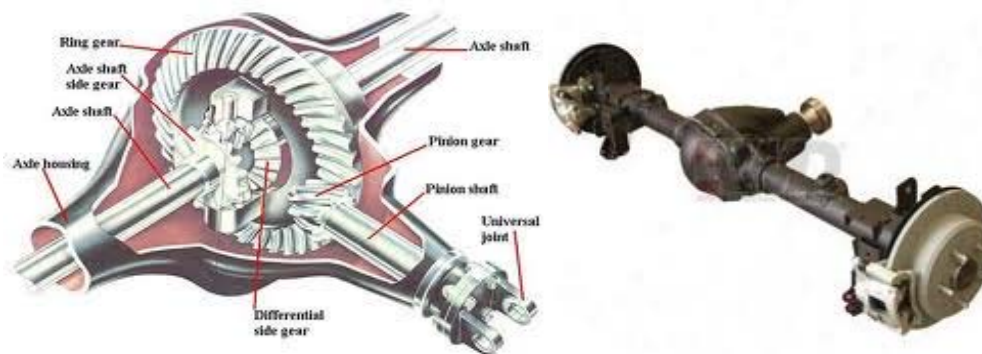


Fig: Rear Axle

The functions of rear axle are as follows:

1. It bears the weight of vehicle body and load due to occupants through springs.
2. It enables to transmit driving and breaking torque to the chassis frame and body of the vehicle.
3. It also experience the side thrust or pull due to any side load on the wheel.
4. It supports the bevel pinion (drive from propeller shaft transmit to the pinion), bevel gear, cage of sun gear and star pinions, axle shafts and different support bearings.
5. Rear road wheels are mounted on the axle shaft.
6. The differential mechanism enables to move outer wheel faster than the inner wheel while taking a turn.

Session 7: Front and rear axle

Assignment

1. Make a list of parts of front and rear axle used in the vehicle.

S.No.	List of parts of front and rear axle
6.	
7.	
8.	
9.	
10.	

2. Draw the photograph of front and rear axle of a vehicle.



Session 7 : Front and rear axle

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Front and rear axle system is used for _____.
2. Main parts of front and rear axle are _____, _____ and _____.

Session 7: Front and rear axle

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Discuss the role of front and rear axle.

Part B

Discussed in class the following:

- Why front and rear axle is necessary ?
- Role of front and rear axle in transmission system.
- Function of front and rear axle
- Front and rear axle and its component

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain front and rear axle		
Able to identify the components of front and rear axle		

Session 8: Steering System

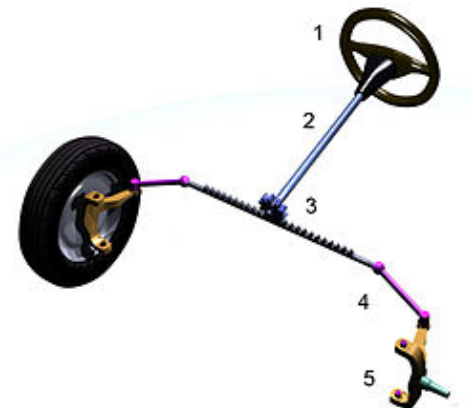
Relevant Knowledge

Role of Steering is to turn the front wheels using a hand-operated steering wheel which is positioned in front of the driver.

It consists of steering column, universal joints to allow it to deviate somewhat from a straight line.

Functions of Steering System:

1. It helps in swinging the wheels to the left or right.
2. It helps in turning the vehicle according to the will of the driver.
3. It provides directional stability.
4. It helps in controlling wear and tear of tyres.
5. It helps in achieving the self-straightening effect.
6. It converts the rotary movement of the steering wheel into an angular turn of the front wheels.
7. It multiplies the effort of the driver by leverage in order to make it fairly easy to turn the wheels.
8. It absorbs a major part of the road shocks thereby preventing them to get transmitted to the hands of the driver.



Rack and pinion steering mechanism: 1 Steering wheel; 2 Steering column; 3 Rack and pinion; 4 Tie rod; 5 Kingpin

Various components of steering system

- Steering wheel
- Steering column
- Steering linkage with universal joint
- Steering gear box
- Drop arm
- Tie rod

- Steering arm
- Track rod with adjuster
- Ball joints
- Stub axle arm

Note:The steering system is fitted with the stub axle arm of front wheel with the help of ball joints

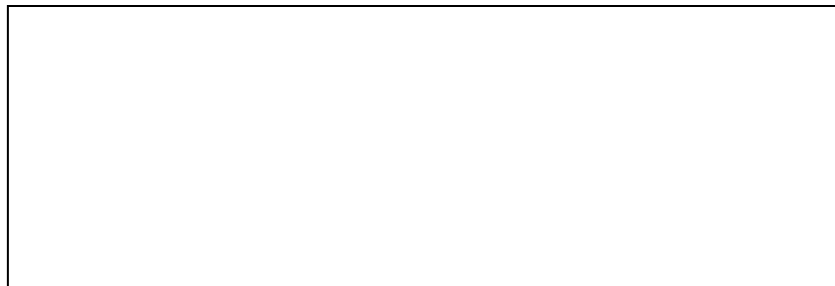
Session 8: Steering System

Assignment

1. Make a list of various components of steering system.

S. No.	List of components
1.	
2.	
3	
4	
5.	

2. Draw the photograph of steering system of a vehicle.



Session 8: Steering System

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Steering system is used for _____.
1. Main parts of steering system are _____, _____ and _____.

Session 8: Steering System

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Discuss the role of steering system.

Part B

Discussed in class the following:

- Why steering system is necessary?
- Role of power steering system.
- Function of steering system

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain steering system		
Able to identify the components of steering system		

Session 9: Suspension System

Relevant Knowledge

Suspension is the term given to the system of springs, shock absorbers and linkages that connects a vehicle to its wheels. Suspension systems serve a dual purpose; contributing to the vehicle's road holding/handling and braking for good active safety and driving pleasure, and keeping vehicle occupants comfortable and reasonably well isolated from road noise, bumps, and vibrations, etc.

Importance of Suspension System

The main purposes of suspension system are as under:

1. To safeguard the occupants against road shocks and provide; riding comfort.
2. To minimize the effects of stresses due to road shocks on the mechanism of the motor vehicle and provide a cushioning effect.
3. To keep the body perfectly in level while travelling over rough uneven ground, i.e. the up and down movement of the wheels should be, relative to the body.
4. To isolate the structure of the vehicle from shock loading and vibration due to irregularities of the road surface without impairing its stability.
5. To provide the requisite height to body structure as well as to bear the torque and braking reactions.

Functions of a Suspension System

1. It provides comfort.
2. It gives cushioning effect.
3. It relieves strain on the frame and other components due to the road shocks.
4. It maintains body level and prevents it from rolling.
5. It provides a good contact for road holding, i.e. the system must always keep the tyres in contact with the road.
6. It transfers driving torque to the wheels as well as breaking force to the chassis.

Various Components of Suspension System

Mechanical Suspension

- Leaf Springs
- Coil Springs
- Rubber Springs
- Torsion bars

Hydraulic Suspension

- Hydraulic Shock Absorber
- Telescopic fork

Air Suspension

Compressed air is used for air suspension system.

Session 9: Suspension system

Exercise: Assignment

1. List the component of Suspension system.

S. No.	Name of component
1	
2.	
3.	
4	
5	

2. Draw the photograph of parts of suspension system of a vehicle.



Session 9: Suspension system

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Propeller shaft is used for _____.
2. Universal joint account for up and down movement of _____
3. Slip joints is used for _____.
4. Front axle is used for _____
5. Rear axle helps in _____.
6. Steering system help in swinging the wheels to the _____ or _____.

Session 9: Suspension system

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Discuss the suspension system.

Part B

Discussed in class the following:

- Role of suspension system?
- Function of suspension system
- Component of suspension system.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to draw propeller shaft		
Able to identify the components of propeller shaft		

Session 10: Wheel and Tyre

Relevant Knowledge

Wheels and Tyre

The wheel is an important component of a vehicle. Wheel is assembly hub, disc or spokes, rim, tyre and tube. The wheels not only support the weight of the vehicle, but also protect it from the road shocks. All the four wheels must resist the braking stresses and withstand side thrust.

Functions the wheel:

1. Strong enough to withstand the weight of the vehicle.
2. Flexible to absorb the road shocks.
3. Able to grip the road surface.
4. Perfectly balanced dynamically and statically.
5. Light and easily remarkable.

Rim: The rim is the "outer edge of a wheel, holding the tire." It makes up the outer circular design of the wheel on which the inside edge of the tire is mounted on vehicles such as automobiles. For example, on a bicycle wheel the rim is a large hoop attached to the outer ends of the spokes of the wheel that holds the tire and tube.



Fig : Photograph of Rim

Different types of Wheel Rims

- Disc wheel rim
- Wire spoke wheel rim (used in motor cycle, bicycle)
- Split wheel rim (used in scooter)
- Heavy vehicle wheel rim (available in three piece and four piece including locking ring).

Tyre

The tyre is mounted on the wheel rim. It has to carry the vehicle load and provide a cushioning effect. It must produce a minimum noise, while the wheel is turning on the road. It resists the tendency for the vehicle to over steer. It should have good grip while accelerating and braking the vehicle on both the dry and wet roads.



Fig : Photograph of Tyre

Desirable Tyre Properties

A tyre must have the following desired properties:

1. **Non-skidding.** The tyre should not skid or slip on the road surface. It should have good grip.
2. **Uniform wear.** The tyre must get wear uniformly over its outer circumference.
3. **Load carrying.** The tyre should be able to carry the vehicle load.
4. **Cushioning.** The tyre should be able to absorb vibrations set-up by the road surfaces, thus providing cushioning effect.
5. **Power consumption.** While rooling on the road, the tyre should consume least power developed by the engine.
6. **Noise.** The tyre should create minimum noise while running on the road.
7. **Balancing.** The tyre should be balanced dynamically as well statically.

Function of Tyre

1. Carry the load of the vehicle
2. Absorb the small road shocks
3. Reduce the vibration to some extent.
4. Transmit the power from the engine through gearbox propeller shaft and rear axle to the ground with which the vehicle moves.
5. The treads made on the tyres grip the road for better traction.

Types of Tyre

1. Solid Tyre (used in baby cycle)
2. Tube Tyre (used in almost all types of vehicles)
3. Tubeless tyre (used in modern cars)

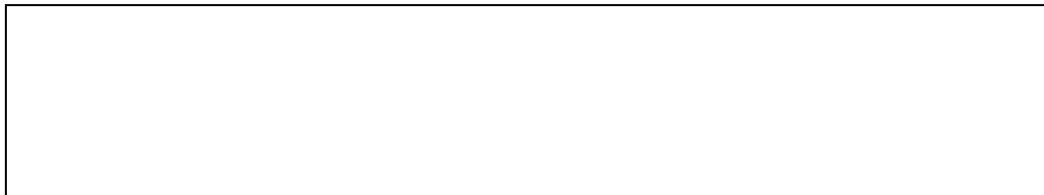
Session 10: Wheel and Tyre

Exercise: Assignment

1. List the different type of rim.

S. No.	Name of rim
1	
2.	
3.	
4	
5	

2. Draw the photograph of wheel and rim of a vehicle.



Session 10: Wheel and Tyre

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Wheel is used for _____.
2. Properties of tires are _____, _____ and _____

3. Rim is used for _____.
4. Tube is used for _____
5. Rim is outer edge of _____.

Session 10: Wheel and Tyre

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Discuss the wheel and tyre

Part B

Discussed in class the following:

- Role of wheel and tyre
- Function of wheel
- Component of wheel.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to draw wheel and tyre		
Able to identify the components of wheel and tyre		

Session 11: Brake Related Knowledge

Brake

Brakes are one of the most important control components of a vehicle. They are required to stop the vehicle within the smallest possible distance and this is done by converting the kinetic energy of the wheels into the heat energy which is dissipated into the atmosphere.



Fig : Brake

Functions of Brakes

There are two distinct functions of the brakes:

1. To stop or slow down the vehicle in the shortest possible distance in emergencies.
2. To control the vehicle speed while moving on plain roads and hills.

Requirements of a good breaking system

1. The brakes should stop the vehicle in shortest possible distance and time.
2. The brakes should work equally well on fair or bad roads.
3. Pedal effort applied by the driver should not be more so as not to strain the driver.
4. Brakes should work equally well in all weathers.
5. It should have very few wearing parts.
6. It should require little maintenance.
7. Brakes, when applied should not disturb steering geometry.
8. There should be minimum sound when brakes are applied.

Types of Brakes

1. With respect of application:
 - (a) Foot brake
 - (b) Hand brake
2. With respect to the method of braking contact:
 - (a) Internal Expanding brakes
 - (b) External contracting brakes (e.g. disc brakes of automobile and railway brakes)
3. With respect to the brake gear:
 - (a) Mechanical brakes
 - (b) Power brakes

4. With respect to the nature of power employed:
- (a) Vacuum brakes
 - (b) Air brakes
 - (c) Hydraulic brakes
 - (d) Hydraulic brake assisted with air
 - (e) Hydrostatic brakes
 - (f) Electric brakes

Session 11: Brake

Exercise: Assignment

1. List the different types of brakes used in automobile.

S.No.	Types
1	
2.	
3.	
4	
5	

2. Draw the photograph of brake of a vehicle.



Session 11: Brake

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Brakes are used for _____ component of a vehicle
2. Tubes are used for _____.
3. Functions of a brake is _____ or _____ vehicle .
4. Brake should work in _____ or _____ roads.

Session 11: Brake

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Role of brake

Part B

Discussed in class the following:

- Importance of brake in the automobile
- Brake for the automobile
- Properties of good brake system.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to draw the brake		
Able to identify different type of brake.		

Session 12: Electrical and Electronic System

Relevant Knowledge

It is a very important system of a car as now days all the automobile vehicles are running with the help of electrical and electronic system.

Electrical and Electronics System

The electrical and electronic system consists of following:

- **Starting System:** The starting motor is driven by means of the current taken from the battery.
- **Ignition System:** The function of the ignition system is to produce a spark in the engine combustion chamber at the end of the compression stroke.
- **Generating or Charging System:** The function of the charging system in an automobile is to generate, regulate and supply the electrical energy for charging the battery.
- **Lighting System:** It consists of various types of lighting used during the vehicle running, such as head light, tail light, fog light, brake light, reversing light, left and right indicators, parking light, cabin light, panel board lights, etc.
- **Connections for other accessories:**

MAIN COMPONENT OF THE ELECTRICAL SYSTEM

Starting System	Generating or Charging System	Ignition System	Lighting System	Accessories
<ul style="list-style-type: none"> • Battery • Starting Motor • Motor Control 	<ul style="list-style-type: none"> • Generator/ Alternator • Ammeter • The cut-out Switch • The battery • Voltage and current regulator 	<ul style="list-style-type: none"> • Battery • Ignition switch • Ignition coil • Distributor • Spark plugs • Contact breaker • Automatic 	<ul style="list-style-type: none"> • Head light • Side light • Rear light • Fog Lamps • Number plate illumination lamp • Interior lights 	<ul style="list-style-type: none"> • Horns • Wind screen wiper • Electric fuel pump • Fuel gauges • Temperature gauge • Radio sets

		advance and retard unit • Vacuum control unit	• Indicator flashers	• Cigar lighter/mobile phone charger • Heater • Wind screen defroster • Signaling devices
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NOTE: In modern vehicles various types of electronic sensors and actuators are fitted in different system of the engines, which are also operated electrically.

Session 12: Electrical and Electronic System

Exercise: Assignment

- List the different component using electrical and electronic system.

S.No.	List of component
1	
2.	
3.	
4	
5	

- Draw the photograph of electrical items of a vehicle.

Session 12: Electrical and Electronic System

Exercise: Assignment

Answer the following questions

(Use additional sheets of paper if necessary)

A. Fill in the blanks

1. Electrical system are used for _____.
2. Electronic system help _____ a vehicle
3. Charging system is used for _____ vehicle.
4. Important accessories used in vehicle having electrical system are _____.

Session 12: Electrical and Electronic System

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

Role of Electrical and Electronic System

Part B

Discussed in class the following:

- Importance of electrical and electronic system in the automobile
- Components using electrical and electronic system
- Advantages of electronic system.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain the advantages of electrical & electronic system		

Session 13: Air Conditioning system

Relevant Knowledge

Automobile Air Conditioner

During summer, an automobile requires considerable amount of refrigerating capacity to maintain cool comfort conditions in the sitting space. Similarly when moving in a cold day in winter, the same vehicle would require considerable heating capacity to keep it comfortably warm for passengers.

Modern day automobiles have an air conditioning unit to maintain suitably controlled temperature and humidity conditions inside the vehicle. An air conditioner is a refrigeration machine requiring electrical energy. In automobiles its air conditioner draws energy from the battery system. The battery of course is charged by energy of the engine.



Fig : Air Conditioner in Car

For heating purposes, the warm water from the engine cooling system is used. The heat required to warm the automobile is generally provided by circulating warm water through a heating coil.

The air conditioner also serves to clean the air along with the control of temperature level. During summer days humidity of the air inside the vehicle is reduced with air-conditioner in operation. This results in creating comfortable conditions inside the automobile.

Car air conditioner comes inbuilt in the car and same can be fitted in car also

Different components of Automobile Air-conditioning system

- Compressor
- Magnetic Clutch
- Condenser
- Receiver-driver (or dehydrator)

- Expansion valve
- Evaporator.
- Suction throttling valve

Session 13: Air Conditioning system

Exercise: Assignment

1. List the different component of air conditioning system.

S.No.	List of component
1	
2.	
3.	
4	
5	

2. Draw the photograph of air conditioner of a vehicle.



Session 13: Air Conditioning system

Exercise: Assignment

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Air conditioning system are used for _____.
2. Air conditioning system help _____ in a vehicle
3. Passive safety helps in _____.

4. Active system is used for _____ vehicle.
5. Important accessories used in vehicle having air conditioning system are _____.

Session 13: Air Conditioning system

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

Role of Air Conditioning System

Part B

Discussed in class the following:

- Comfort used by active and passive safety
- Components of air conditioning system
- Advantages of air conditioning system.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain the advantages of Air Conditioning system		

Session 14: Active & Passive safety

Relevant Knowledge

Active and Passive Safety and Security Systems

There are different safety and security systems available in the market and some of which are fitted by the manufacturer. Following are the few active and passive security systems.

Safety Glass

Safety glass is used in all auto windows and doors. The safety glass employed in today's vehicles is of two types: laminated or tempered. These types are considered to be safety glass because of their construction.

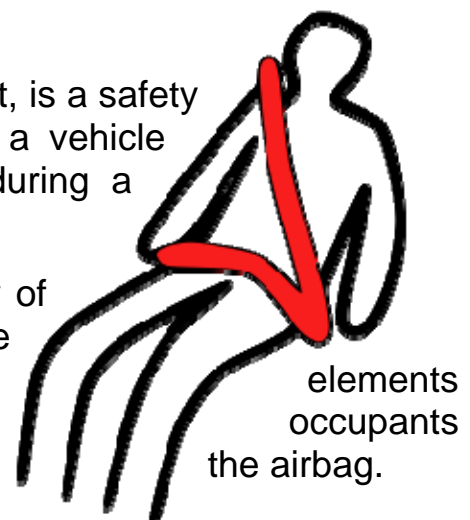
Laminated plate glass is used to make all wind shields. This type of glass consists of two thin sheets of glass with a thin layer of clear plastic between them. Some glass manufacturers have increased the thickness of the plastic material for greater strength. When this type of glass is broken, the plastic material will tend to hold the shattered glass in place and prevent it from causing injury.

Tempered glass is used for side and rear window glass but rarely for windshields. This type of glass is a single piece of heat-treated glass and has more resistance to impact than regular glass of the same thickness.

Seat Belts

A seat belt, sometimes called a safety belt, is a safety harness designed to secure the occupant of a vehicle against harmful movement that may result during a collision or a sudden stop.

A seat belt reduces the likelihood and severity of injury in a traffic collision by stopping the vehicle occupant from hitting hard against interior of the vehicle or other passengers, by keeping positioned correctly for maximum benefit from



elements
occupants
the airbag.

In most vehicles the passenger must fasten the seat belt for crash protection. The passive safety system

Fig : Seat Belt

belt

operates automatically whenever there is an accident. No action is required of the occupant to make it functional.

In modern cars seat belts are also provided for rear seat occupants also.

Air Bags

An airbag is a vehicle safety device. This is one of the passive safety systems for the occupants of car. The electrical system of air bags includes the **impact sensors** and the electronic control module.



Fig : Air Bags

When there is an accident the sensor detects the impact and the air bag operates to save the driver and other occupants.

Energy-Absorber Safety Bumpers

Modern bumpers are designed to absorb the energy of a low-speed impact, minimizing the shock directed to the frame and to the occupants of the vehicle. Most energy absorbers are mounted between the bumper face bar or bumper reinforcement bar and the frame.

Security and Antitheft Devices

There are three basic types of antitheft devices available: locking devices, disabling devices, and alarm systems.

Session 14: Active & Passive safety

Exercise: Assignment

1. List the different Active & Passive safety device.

S.No.	List of devices
1	
2.	
3.	
4	
5	

Session 14: Active & Passive safety

Exercise: Assignment

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Air bags are used for _____.
2. Seat belt _____ in a vehicle
3. Passive safety helps in _____.
4. Active system is used for _____ vehicle.
5. Important accessories used in vehicle having are _____.

Session 14: Active & Passive safety

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

Role of Active & Passive safety

Part B

Discussed in class the following:

- Comfort used by active and passive safety
- Components of active and passive safety
- Advantages of active and passive safety.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain about active and passive safety		
Able to identify the components of active and passive safety		

Suggested Reading

Books

Title	Author	Publisher
Automobile Engineering Vol I	Kirpal Singh	Standard Publishers
Automobile Engineering, Vol II	Kirpal Singh	Standard Publishers
Text Book of Automobile Engineering	R. K. Rajput	Laxmi Publications
Automobile Engineering by	R. K. Singal	S. K. Kataria and Sons
Automobile Engineering Theory	Kapil Dev	Computech Publications
Automobile Engineering,	K. M. Moeed	S. K. Kataria and Sons

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