

**A Text Book on  
Automobile Chassis and Body Engineering**  
(A text book for +2 Vocational and Diploma Students of Mechanical  
Engineering)

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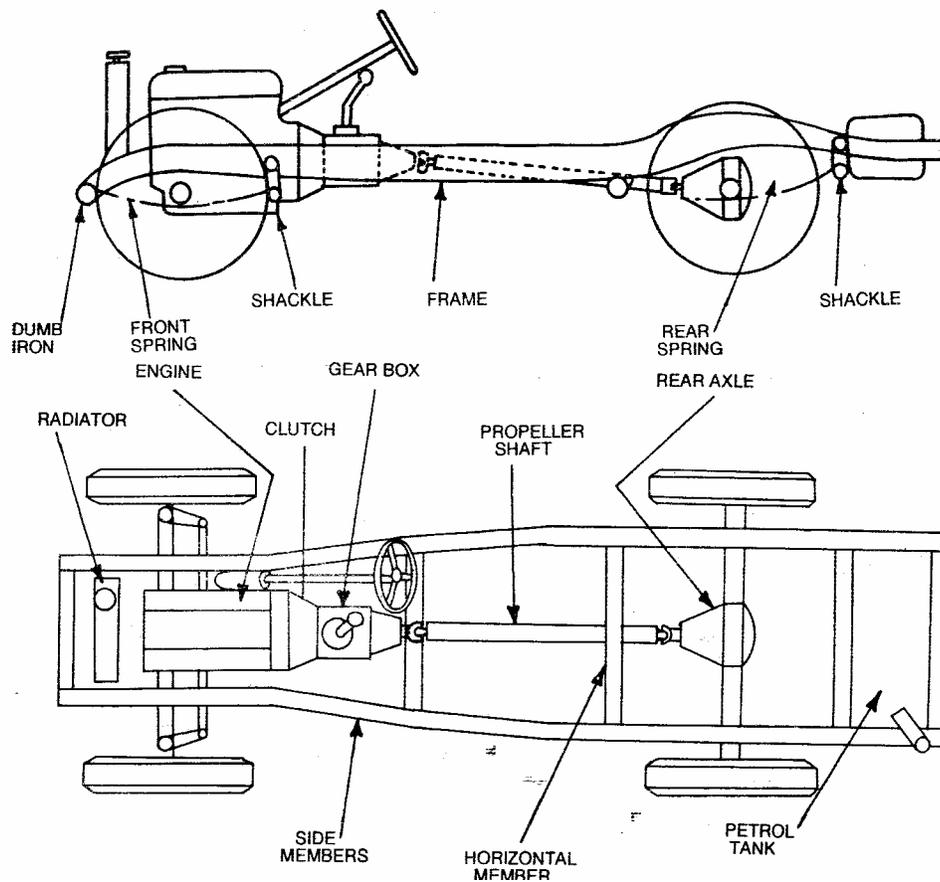
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## CHAPTER 1

# CHASSIS FRAME AND BODY

Introduction of Chassis Frame: Chassis is a French term and was initially used to denote the frame parts or Basic Structure of the vehicle. It is the back bone of the vehicle. A vehicle with out body is called Chassis. The components of the vehicle like Power plant, Transmission System, Axles, Wheels and Tyres, Suspension, Controlling Systems like Braking, Steering etc., and also electrical system parts are mounted on the Chassis frame. It is the main mounting for all the components including the body. So it is also called as Carrying Unit.

Layout of Chassis and its main Components:



The following main components of the Chassis are

1. Frame: it is made up of long two members called side members riveted together with the help of number of cross members.
2. Engine or Power plant: It provides the source of power
3. Clutch: It connects and disconnects the power from the engine fly wheel to the transmission system.
4. Gear Box

5. U Joint
6. Propeller Shaft
7. Differential

#### FUNCTIONS OF THE CHASSIS FRAME:

1. To carry load of the passengers or goods carried in the body.
2. To support the load of the body, engine, gear box etc.,
3. To withstand the forces caused due to the sudden braking or acceleration
4. To withstand the stresses caused due to the bad road condition.
5. To withstand centrifugal force while cornering

#### TYPES OF CHASSIS FRAMES:

There are three types of frames

1. Conventional frame
2. Integral frame
3. Semi-integral frame

1. Conventional frame: It has two long side members and 5 to 6 cross members joined together with the help of rivets and bolts. The frame sections are used generally.

- a. Channel Section - Good resistance to bending
- b. Tabular Section - Good resistance to Torsion
- c. Box Section - Good resistance to both bending and Torsion

2. Integral Frame: This frame is used now a days in most of the cars. There is no frame and all the assembly units are attached to the body. All the functions of the frame carried out by the body itself. Due to elimination of long frame it is cheaper and due to less weight most economical also. Only disadvantage is repairing is difficult.

3. Semi - Integral Frame: In some vehicles half frame is fixed in the front end on which engine gear box and front suspension is mounted. It has the advantage when the vehicle is met with accident the front frame can be taken easily to replace the damaged chassis frame. This type of frame is used in FIAT cars and some of the European and American cars.

#### VARIOUS LOADS ACTING ON THE FRAME:

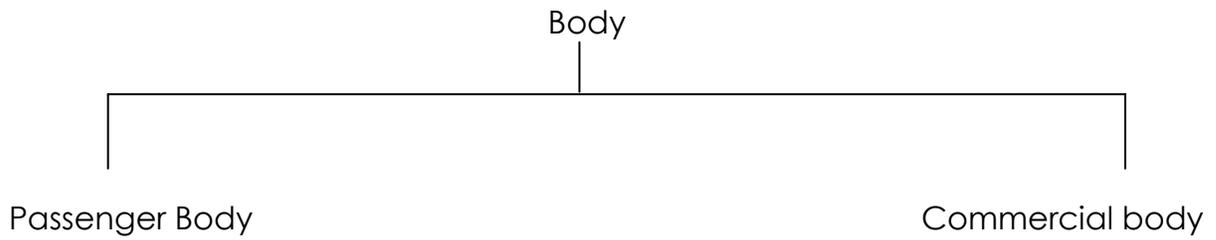
Various loads acting on the frame are

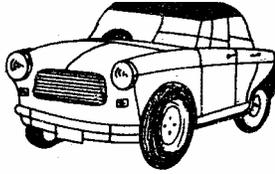
1. Short duration Load - While crossing a broken patch.

2. Momentary duration Load - While taking a curve.
3. Impact Loads - Due to the collision of the vehicle.
4. Inertia Load - While applying brakes.
5. Static Loads - Loads due to chassis parts.
6. Over Loads - Beyond Design capacity.

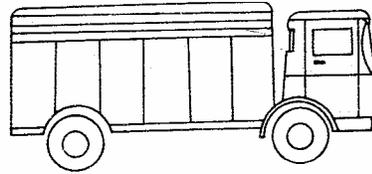
STATE THE DIFFERENT BODIES USED IN AUTOMOBILES:

The Automobile bodies are divided in two groups

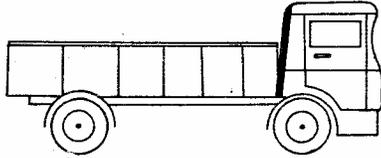




1. Car



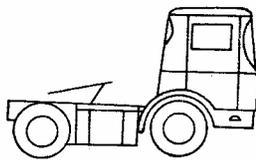
2. Truck Punjab body or Straight truck



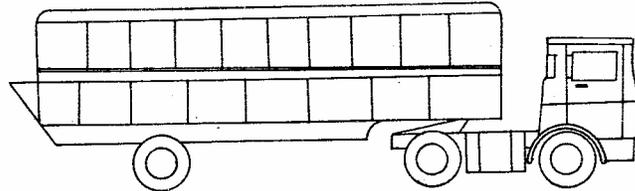
3. Truck half body



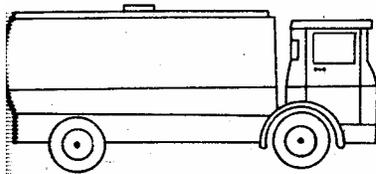
4. Truck platform type



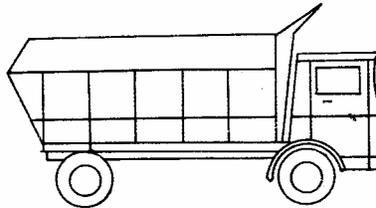
5. Tractor



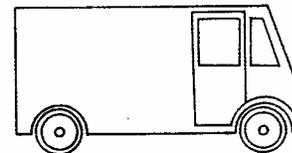
6. Tractor with articulated trailer.



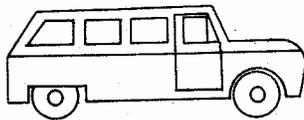
7. Tanker



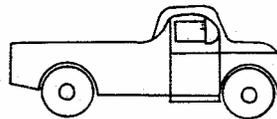
8. Dumper truck



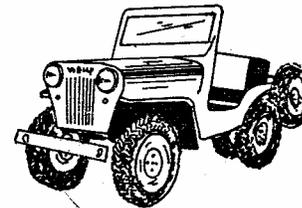
9. Delivery Van



10. Station wagon



11. Pick-up



12. Jeep

According to Chassis design the body can be divided into

1. Conventional Type
2. Integral Type
3. Semi- Integral Type

According to other usage:

1. Light vehicle Bodies - cars, jeeps
2. Heavy vehicle Bodies - Busses, Lorries
3. Medium vehicle Bodies - Vans, Metadoors

## REQUIREMENTS OF BODIES FOR VARIOUS TYPES OF VECHILE:

The body of the most vehicle should fulfill the following requirements:

1. The body should be light.
2. It should have minimum number of components.
3. It should provide sufficient space for passengers and luggage.
4. It should withstand vibrations while in motion.
5. It should offer minimum resistance to air.
6. It should be cheap and easy in manufacturing.
7. It should be attractive in shape and colour.
8. It should have uniformly distributed load.
9. It should have long fatigue life
10. It should provide good vision and ventilation.

Short Answer Questions:

1. List out the various components of chassis?
2. What are the functions of Chassis frame?
3. List out the types of Chassis frame?
4. What are the frame sections used in Automobiles?
5. What are the requirements of Bodies for various types of vehicles?

Essay Type Questions:

1. Draw the layout of conventional Chassis with a neat diagram and explain about various parts on it?
2. What are the different classification of bodies used in Automobiles and explain?

## CHAPTER 2

**STEERING SYSTEM**

**Introduction:** This system provides the directional change in the movement of an Automobile and maintain in a position as per the driver's decision without much strain on him.

## REQUIREMENTS OF STEERING SYSTEM:

- a. It must keep the wheel at all times in to rolling motion with out rubbing on the road.
- b. This system should associate to control the speed.
- c. It must light and stable.
- d. It should also absorb the road shocks.
- e. It must easily be operated with less maintenance.
- f. It should have self-centering action to some extent.

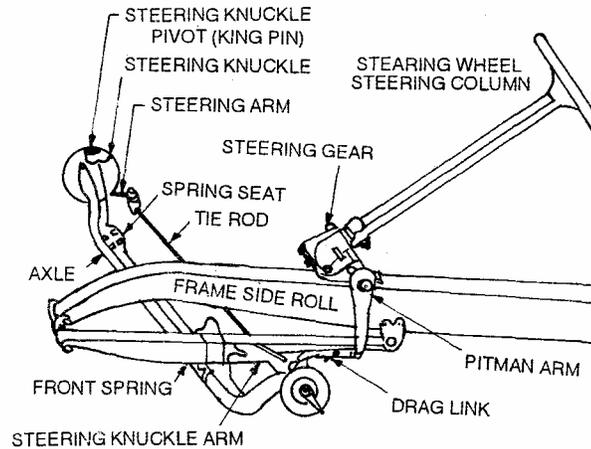
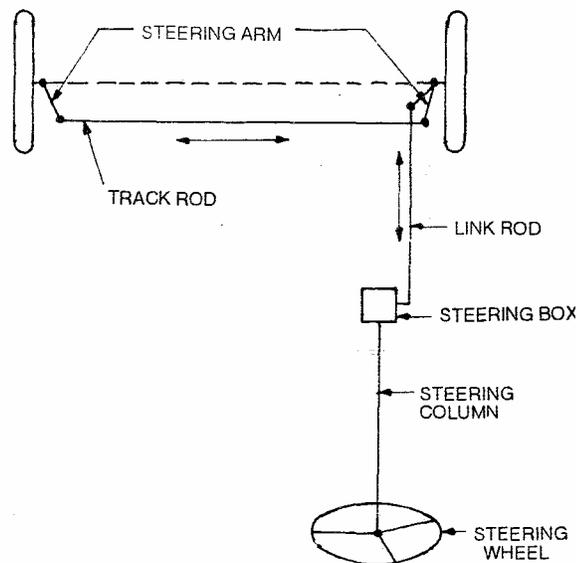


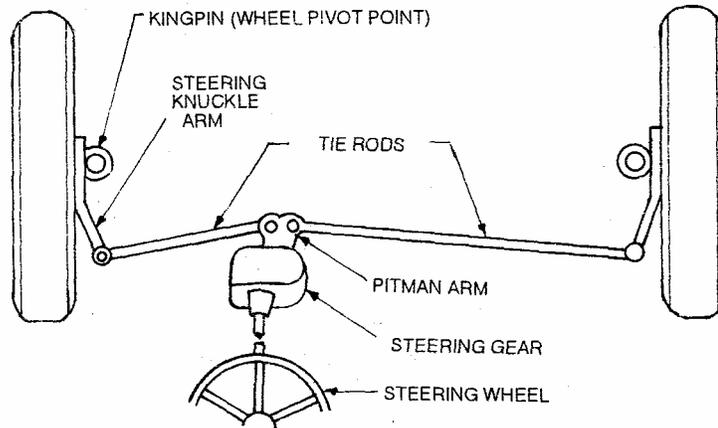
Fig. 28.18. Conventional steering linkage.



Functions of Steering System:

1. It helps in swinging the wheels to the left or right.
2. It helps in turning the vehicle at the will of the driver.
3. It provides directional stability.
4. It is used to minimize the tyre wear and tear.
5. It helps in achieving self-centering efforts.
6. It absorbs major part of the road shocks.

Main Components of Steering System:



The following are the main components of steering system are

1. Steering Wheel
2. Steering column or shaft
3. Steering Gear
4. Drop Arm or Pitman Arm
5. Drag Link
6. Steering Arm
7. Track-Arms
8. Track Rod or Tie-Rod
9. Adjusting Screws

Types of Steering Gear Boxes:

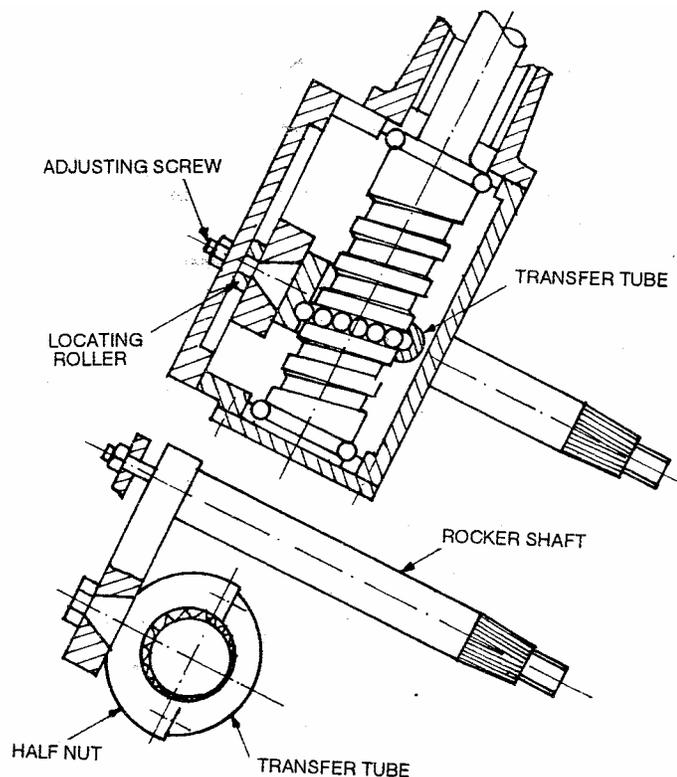
1. Worm and Wheel Steering Gear.
2. Worm and Roller Steering Gear.
3. Re-circulating Ball type Steering Gear.
4. Rack and Pinion type Steering Gear.
5. Cam and Roller Gear type Steering Gear.
6. Cam and Peg Steering Gear.
7. Cam and Double lever Steering Gear.
8. Worm and Sector Type Steering Gear.

Functions of Steering Gear Box:

1. It converts the Rotary movement of the steering wheel in to the angular turning of the front wheels.
2. It also multiplies drivers efforts and give MECHANICAL ADVANTAGE.

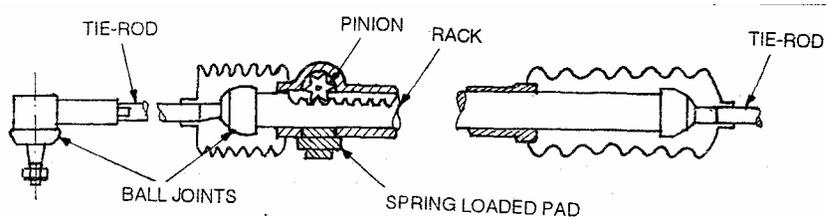
1. Worm and Wheel Type: This type of steering gear has a square cut screw threads at the end of the steering column; which forms a worm, at the end of it a worm wheel is fitted and works rigidly with it. Generally covered shaft is used for the worm wheel. The worm wheel can be turned to a new position the drop arm can be readjusted to the correct working position.

2. Re-circulating Ball Type: In this type of gear box the endless chain of balls are provided between the worm and nut members. The nut form a ring of rack having an axial movement. So that the sector on the rocker shaft racks, the balls roll continuously between the worm and nut. Being provided with return chambers at the ends of the worm. This method reduces friction between worm and nut members. This type of steering gear is used for heavy vehicles.



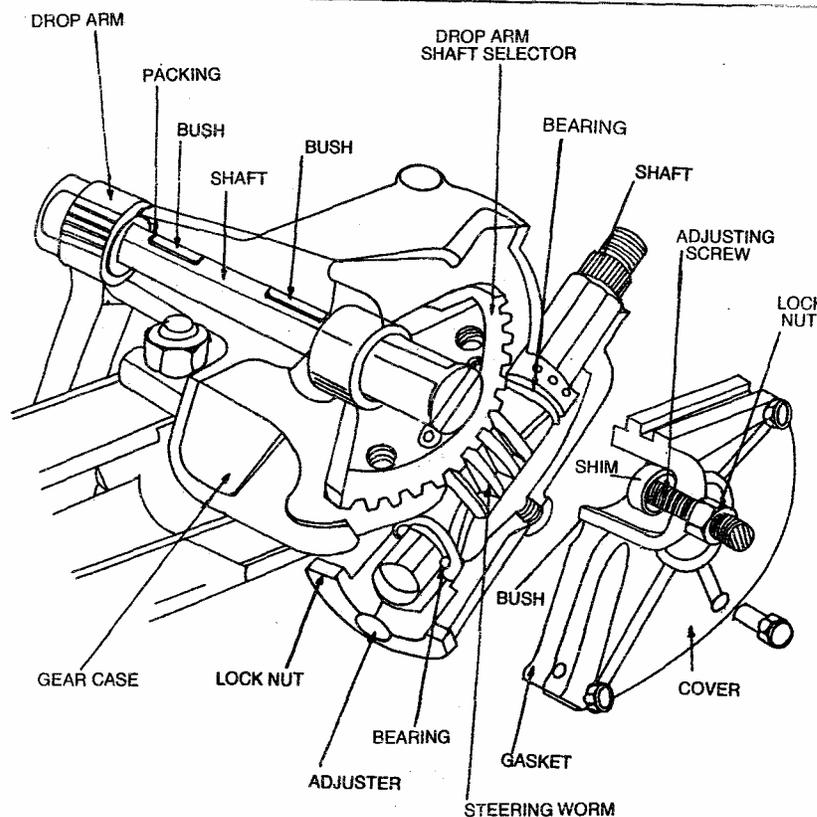
3. Rack and Pinion Type: This is common manual type of steering gear box is used in most of the vehicles. In this type of steering a pinion is provided the bottom end of the steering column. The teeth of the pinion wheel in mesh with corresponding teeth provided on the rack, the end of which are

connected to the stub axle through the rod. The rotating motion of the pinion operates the rack in FORE and AFT direction which in turn operates the stub axle.



4. Cam and Lever Type: The cam and lever steering uses one or two lever studs fitted in taper roller bearing. When the worm in the form of helical groove rotates the stub axle and it also rotates along with it. This imports a turning motion to the drop arm shaft.

5. Worm and Sector Type: In this type the worm on the end of the steering shaft meshes with a sector mounted on a sector shaft. When the worm is rotated by rotation of the steering wheel, the sector also turn rotating the sector shaft. Its motion is transmitted to the wheel through the linkage. The sector shaft is attached to the drop arm or pitmen arm.



Power Steering: Power steering reduces much strain on the part of the driver while negotiating sharp curves. It makes easy to turn sharp corners. It is usually

arranged to be operative when the effort of steering wheel exceeds a pre-determined value. It is fitted on heavy commercial vehicles and medium cars.

**Steering Linkages:** Steering Linkage is a connection of various links between the steering gear box and the front wheels. The motion of the pitman arm and steering gear box is transferred so the steering knuckles of the front wheels through the steering linkages. The swinging movement of the pitman arm from one side to the other side gives angular movement to the front wheel through the steering linkages.

Types of steering Linkages:

1. Conventional steering Linkage.
2. Direct cross type steering linkage
3. Three piece steering linkage
4. center arm steering linkage
5. Relay type steering linkage.

**Slip Angle:** The angle between direction of the motion of the vehicle and the center plane of the tyre is known as Slip Angle. It ranges from  $8^\circ$  to  $10^\circ$ .

**Under steer:** When the front slip angle is greater than that of rear, the vehicle tends to steer in the direction of side force. Then it is known as under steer. This provides greater driving stability, especially when there is a side wind.

**Over Steer:** When the rear slip angle is greater than that of front slip angle, the vehicle tends to move away from the direction of center path. This is known as over steer. This is advantageous when the vehicle moving on the road having many bends curves.

**Steering Gear Ratio or Reduction Ratio:** It has been defined as the " number of turns on the steering wheel required to produce one turn of steering gear cross shaft to which the pitman arm is attached. Generally it varies between 14:1 and 24:1.

**Turning Radius:** It is the radius of the circle on which the outside front wheels moves when the front wheels are turned to their extreme outer position. This radius is 5 to 7.5 m for buses and trucks.

**Wheel Alignment:** It returns to the positioning of the front wheels and steering mechanism that gives the vehicle directional stability, reduce the tyre wear to a minimum.

Factors effects the wheel alignment:

1. Factors pertaining to wheel:-
  - a. Balance of wheels(Static and Dynamic)
  - b. Inflation of tyre.
  - c. Brake adjustments.
2. Steering Linkages.
3. Suspension System
4. Steering Geometry –a. caster b. camber c. king pin inclination d. toe-in and toe-out etc.,

**Steering Geometry:** It refers to the angular relationship between the front wheels and parts attached to it and car frame.

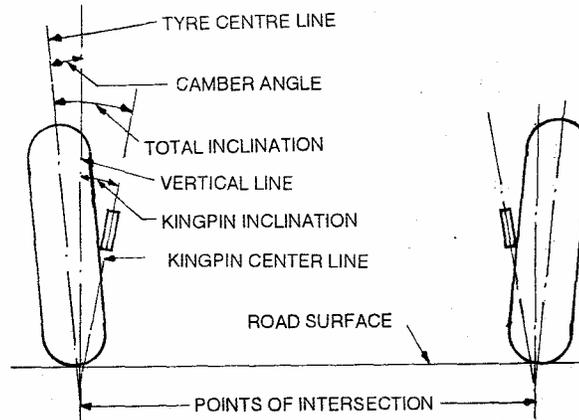
The steering Geometry includes

1. Caster angle
2. Camber angle
3. King-pin inclination
4. toe-in
5. toe-out etc.,

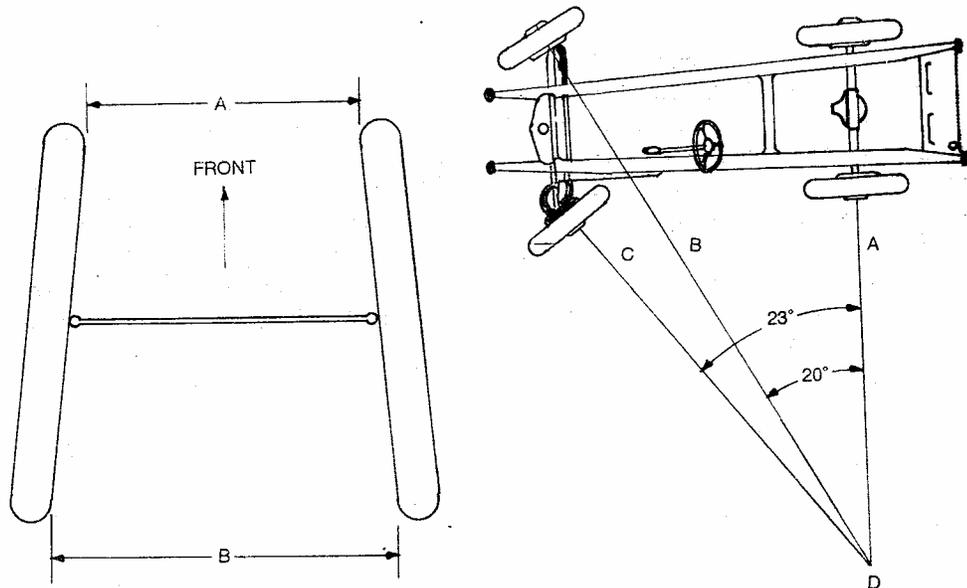
**Caster Angle:** This is the angle between backward or forward tilting of the king pin from the vertical axis at the top. This is about 2° to 4°. The backward tilt is called as positive caster. The forward tilt is called negative caster.

**Camber:** The angle between wheel axis to the vertical line at the top is called camber angle. It is approximately ½° to 2°.

**King-pin inclination:** It is the angle between vertical line to the king pin axis. The inclination tends to keep wheels straight ahead and make the wheels to get return to the straight position after completion of a turn. The inclination is normally kept 7° to 8°.



**Toe-in:** It is the amount in minimum at the front part of the wheel points inwards approximately 3 to 5 mm. It prevents side slipping excessive tyre wear, proper rolling of front wheels and steering stability.



**Toe-out:** It is the difference in angles between two front wheels and vehicle frame during turning. It is used to prevent dragging of tyre during turn.

**Reversible steering:** When the deflection of road wheels is transmitted through the steering wheel to road surface, the system is called Reversible.

If every imperfection of road surface causes the steering to rotate, it causes much strain on the part of the driver to control the vehicle. It causes much strain on the part of the driver to control the vehicle. Therefore such of the reversibility is not desired. But, some degree of reversibility desired, so that the wheel becomes straight after taking a curve.

**Irreversible steering:** If the front road wheels does not transfer any deflection to the steering which is called irreversible steering. After negotiating a curve and the steering wheel not returned easily, there causes the production of

undue stresses on the steering mechanism, therefore some degree of irreversibility is also desired.

**Steering Mechanism:** There are two types of steering gear mechanisms

1. Davis Steering gear
2. Ackermann Steering gear]

**1. Davis Steering Gear:** The Davis Steering gear has sliding pair, it has more friction than the turning pair, therefore the Davis Steering Gear wears out earlier and becomes inaccurate after certain time. This type is mathematically accurate.

The Davis gear mechanism consists of cross link KL sliding parallel to another link AB and is connected to the stub axle of the two front wheels by levers ACK and DBK pivoted at A and B respectively. The cross link KL slides in the bearing and crosses pins at its ends K and L. The slide blocks are pivoted on these pins and move with the turning of bell crank levers as the steering wheel is operated. When the vehicle is running straight the gear is said to be in its mid-position. The short arms AK and BL are inclined at an angle  $90^\circ + \alpha$  to their stub axles AC and BD respectively. The correct steering depends upon the suitable selection of cross arm angle  $\alpha$ , and is given by

$$\tan \alpha = \frac{b}{2l} \quad \text{Where } b = AB = \text{distance between the pivots of front axle.} \\ l = \text{wheel base}$$

**2. Ackermann Steering System:** It has only turning pair. It is not mathematically accurate except in three positions. The track arms are made inclined so that if the axles are extended they will meet on the longitudinal axis of the car near rear axle. This system is called Ackermann steering.

#### STEERING DEFECTS AND THEIR CAUSES AND REMEDIES:

1. Wheel wobble: The oscillation of the front wheels at low speeds is called wheel wobble.

Causes	Remedies
a. In Correct Dynamic Balancing of wheels.	a. Correct the wheel balance
b. Uneven Tyre pressure	b. Check the tyre pressure
c. The camber may be incorrect or uneven	c. Adjust suitably.
d. The ball joints may be worn out.	d. Replace with a new one

e. Excessive caster	e. Adjust
f. Steering gear or wheel bearing may be loosen.	f. Adjust or Replace
g. Tyre may worn unevenly	g. Replace

2. High Speed shimmy: The oscillation of the front wheels at high speed is called high speed shimmy.

- a. Wheel Rim may be buckled - Straighten or replace
- b. Front wheel bearing may loose or worn out - Tighten or Replace
- c. Faulty shock Absorber - Replace
- d. Incorrect toe-in - Adjust

3. Excessive backlash in steering:

- a. Steering gear base may be loose -Tighten
- b. Drop arm may be loose on splines - Replace
- c. Front wheel stub axle bearing loose or worn out-Tighten or Replace
- d. Loose steering Linkages - Tighten Properly

4. Steering Wander: The moving of Vehicle slightly in one side is known as wandering

- a. Tyre pressure in two sides is not equal - Check and correct
- b. Steering knuckle bearing tight -Adjust
- c. Badly worn Tyre - Replace
- d. Incorrect Toe-in - Correct it.

5. Hard Steering: When the effort required for steering is more it is called hard steering.

- a. Low Tyre pressure - Correct pressure
- b. Excessive caster - Adjust
- c. Steering gear too tight - Adjust
- d. Incorrect wheel Alignment - Adjust

## COMPARATIVE STEERING DATA OF SOME INDIAN AUTOMOBILES

S. No	Vehicle make	Type of Steering	Camber	Castor	King pin inclination	Toe-in(mm)	Steering Ratio
1	Hindustan Ambassador Mark II	Rack & Pinion	1/2"	8 1/4"	3"	24	14:1
2	Fiat 1100	Worm & Roller	(0 to 30) degrees +/- 20'	(2 degrees 10 mts +/- 10 mts 30 secs	7 degrees	1 to 9 un laden 7 laden	164:1
3	Jeep CJ3B	Cam & Lever	1 1/2 degrees	3 degrees	7 1/2 degrees	1.2 to 2.4	14:1, 12:1

Short Answer Questions:

1. What are the Requirements of Steering systems?
2. Explain the functions of steering systems?
3. List out the main components of steering system?
4. What are the functions of steering Linkages used the Automobiles?
5. What are the types of steering linkages used the Automobiles?
6. What is meant by wheel wobbling?
7. What are the causes for high Speed Shimmy?

Long Answer Questions:

1. What are the types of steering gear boxes used and explain any one of them?
2. What is meant by Steering Geometry and explain with neat sketches?
3. Explain about different Steering mechanisms i.e. Dan's and Ackerman steering with neat diagrams?
4. Explain the following in brief:
  - a. Slip Angle
  - b. Under Steer and Over Steer
  - c. Reversible Steering and Irreversible steering
  - d. Turning Radius

**CHAPTER –III****BRAKING SYSTEM:****INTRODUCTION:**

Braking is the mechanism in the motor vehicle which is used to slowing down and stopping the vehicle to rest in the shortest possible distance.

**Principle of Braking system:** While operating the braking system the KINETIC ENERGY of moving vehicle is converted in to HEAT ENERGY.

**Functions of Brakes:** Brakes have the following functions.

- 1.It is used to stop the vehicle.
- 2.It is used to control the speed where and when required.
- 3.It is used to control the vehicle while descending along the slope.
- 4.To park the vehicle and held it in stationary position without the presence of Driver.

**Requirements of Automobile Brakes:**

- 1.It should work efficiently irrespective of road condition and quality.
- 2.The retardation must be uniform throughout its application.
- 3.The pedal effort must be within the convenient capacity of the driver.
- 4.It must be reliable and should not be effected by heat water and dust.
- 5.It should be in minimum weight.
- 6.It should have long life.
- 7.It should be easy to maintain and adjust.
- 8.Noise and vibrations are to be minimum.
- 9.There should be provision for secondary brake or parking brake.

**Stopping distance and Braking efficiency:**

For practical measure for braking efficiency that of the minimum distance in which it can be brought in to rest after the brake is applied.

The stopping distance depends upon

- 1.Grip between the tyre and road surface.
- 2.Tyre tread condition.
- 3.Tyre inflation.
- 4.Nature of road surface.

The stopping distance is calculated by

$$D=kv^2$$

Where d=stopping distance in kilometers.

K=Constant depending upon the road and tyre inflation.

V=velocity of the vehicle per hour.

The value of k is 1/25 for 4 wheel braking system.  
 1/12 for 2 wheel braking system.  
 The braking efficiency is calculated by the equation:

$\eta = \frac{V^2}{3D}$  where v=velocity of the vehicle  
 d=stopping distance.

Condition of Brake	Braking efficiency in %
1.Perfect	90%
2.Excellent	77%
3.Good	70%
4.Fair	60%
5.Poor	50%
6.Bad	37%
7.Very bad	30%

Below Fair is very danger.

**Classification of Brakes:** The following are the classifications of Brakes:

**1.By method of power**

- a) Mechanical brakes
- b) Hydraulic brakes
- c) Vacuum brakes
- d) Air brakes
- e) Electrical brakes
- f) Magnetic brakes
- g) Air assisted hydraulic brakes

**2.By method of application:**

- a) Service or foot brakes
- b) Parking or hand brakes

**3.By method of operation:**

- a) Manual
- b) Servo
- c) Power operation

**4. By method of Braking contact**

- a. Internal Expanding Brakes

- b. External Contracting Brakes.

**5. By Method of Applying Brake force:**

- a. Single Acting Brakes.
- b. Double Acting Brakes.

**Types of Mechanical Brakes:**

- a. Drum Brakes (Internal Expanding or External Contracting)
- b. Disc Brakes (Single or Two caliper)

**Drum Brakes:**

Construction: The main components of drum brakes are

1. Brake drum
2. Back plate
3. Brake shoes
4. Brake Liners
5. Retaining Springs
6. Cam
7. Brake Linkages

In this system the wheel is attached to drum. There are brake shoes used to contact the rotating drum for braking operation. The shoes provide lining on their outer surface. The cam is used to lift the brake shoes at one end, other end is connected by some method so as to make as the brake sleeve come into contact in the brake drum. The retaining spring is provided for bringing the brake shoes back to its original position, after releasing the brake pedal. All these parts are fitted in the back plate and enclosed with brake drum. This system .

Working: When the pedal is pressed the cam moves the shoes outwards through linkages, there by coming in frictional contact with the rotating drum. As soon as the brake pedal is released the retaining springs help the brake shoes to brought back and release the brakes.

2. Disc brakes: There are two types of disc brakes:

1. Spot Type
  - a. Swinging Caliper Type
  - b. Sliding caliper type
2. Clutch Type

Construction: The discs are made of gray cast Iron. The brake pressure in case of disc brakes have to be much lighter than the drum brakes.

It consists of rotating disc and two friction pads which are actuated by the four hydraulic wheel pistons contain in two halves of an assembly is called a caliper. The caliper assembly is secured to the steering knuckle in a front wheel brakes. The road wheel is fashioned to the outer surface of the disc. The friction pads rides freely on each side of the discs. They are in position being the hydraulic systems.

Working:

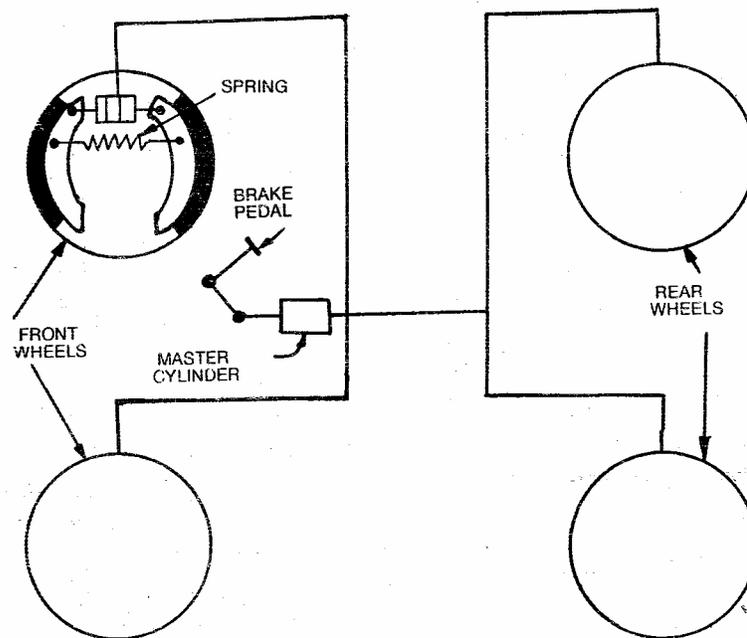
When the brakes is applied hydraulic pressure is supply to the fluid inlet tube, due to which the wheel cylinder piston force the friction pads against the rotating disc. In the released piston, the spring hold the piston pads so that they maintain contact with disc surface.

Construction and Working of Hydraulic systems:

Hydraulic brakes make used of hydraulic pressure to force brake shoes out words against the brake drum based on PASCAL'S LAW.

Construction: The main components of the system is

1. Master Cylinder
2. Wheel Cylinder



The figure shows the master cylinder is connected by tubing to the wheel cylinder, at each of the four wheels. The system is filled with the liquid under light pressure when the brake is not in operation. The brake fluid generally a mixture of glycerin and alcohol or caster oil, denatured alcohol and some additives.

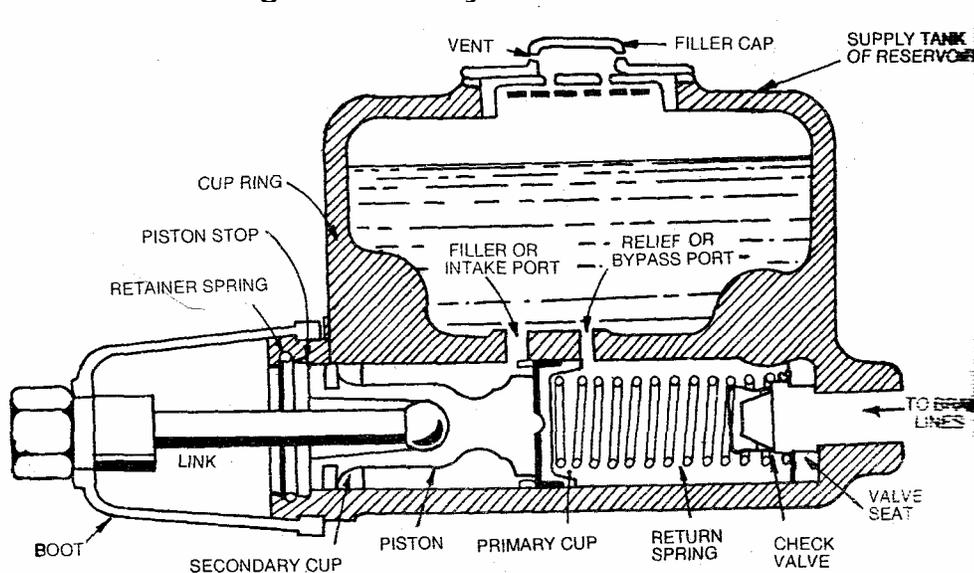
The brakes shoes which are mounted on the inner side of the brake drum and do not rotate. The brake liners are fitted on the outer surface of the

brake shoes. The brake pedal is connected to the master cylinder piston by means of a piston rod.

**Working:** When the brake pedal is pressed the piston is forced in to the master cylinder, the hydraulic pressure is applied equally to all wheel cylinders. The pistons in the wheel cylinders pushed outwards against the brake drum.

When the driver release the brake pedal, the piston in the master cylinder returns back to its original position due to the return spring pressure. Thus the pistons in the wheel cylinder come back in its original inward position. Thus the brakes are released

### Construction and working of Master Cylinder

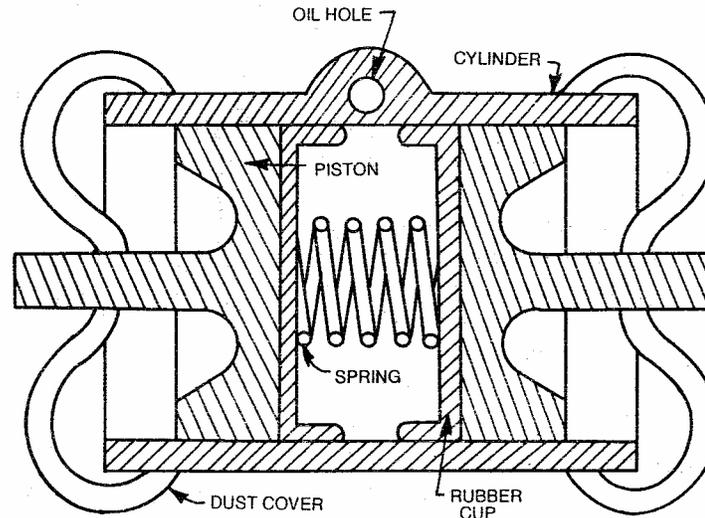


**Master Cylinder:** The Master Cylinder is the heart of the hydraulic brake system. It consists of two main chambers. The fluid reservoir which contains the fluid to supply to the brake system, and the compression chamber in which the piston operates. The reservoir supplies fluid to the brake system through two ports. The larger port is called the filler or intake part and is connected to the hollow portion of the piston between the primary and secondary cups which act as piston seals. The smaller port is called the relief, bypass or compensating port which connects the reservoir directly with the cylinder and lines when the piston is in the released position.

When the brake pedal is depressed, the master cylinder piston moves forward to force the liquid under pressure into the system. The relief port is sealed out of the system. The liquid pressure is conducted to the wheel cylinders, where it forces the wheel cylinder pistons out wards. These pistons force the brake shoes out against the brake drums.

When brake pedal is released, the return spring quickly forces the master cylinder piston back against the piston stop. Because the fluid in the lines returns rather slowly, a vacuum tends to form in the cylinder in front of the piston. This causes the primary cup to collapse to allow the liquid to flow from the reservoir through the filter port past the piston to fill the vacuum.

### Construction and working of Wheel Cylinder



**WHEEL CYLINDER:** Wheel cylinder is the second important hydraulic brake system. It consists of two pistons which can move in opposite directions by the fluid pressure. It is rigidly mounted on the brake shield or backing plate. The boots protect the cylinders from foreign substances. Bleeder valves are provided in the cylinder to permit air and liquid to be pumped out of the system during of the bleeding operation .

Piston cup fits tightly in the cylinder against each piston and seal the mechanism against leakage of the brake fluid. A Spring serves to hold the cups against the piston when the pressure is decreased.

When the brakes are applied the brake fluid enters the cylinder from a brake line connection inlet between the two pistons. It causes to force out the two pistons in opposite directions. This motion is transmitted to the brake shoe. Directly or through links force them against the brake drum, thus applying the brake.

### Construction and working of Tandem master Cylinder

In this master cylinder there are two pistons in the and hydraulic pressure developed in two chambers one for the front left, and rear right brakes and other for the front right and rear left brakes.

In tandem master cylinder one cylinder operates the front brakes while the other cylinder operates the rear brakes.

### Construction and working of Air Brake System:

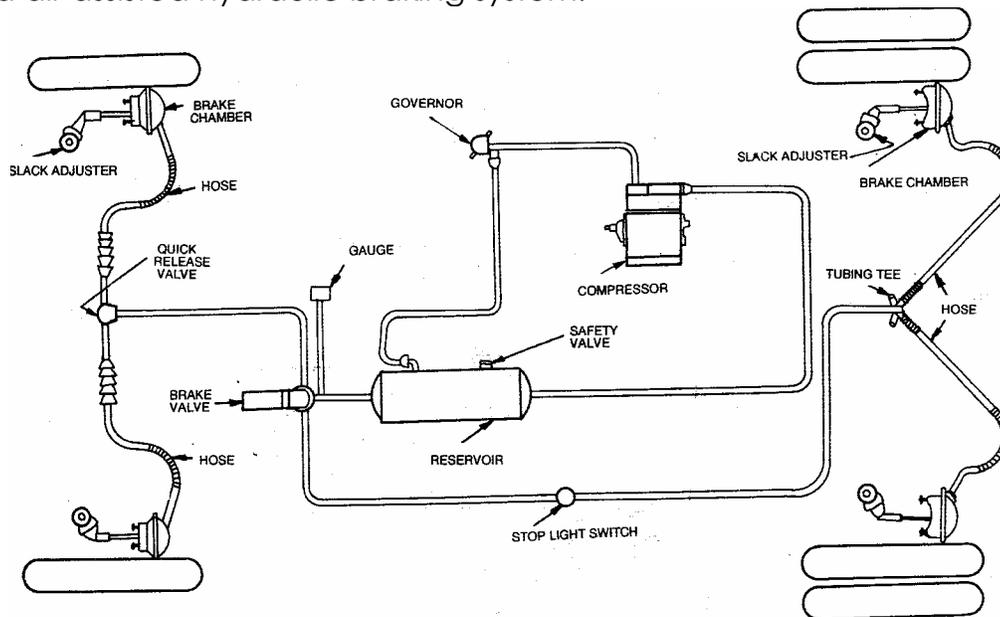
The air brake system consists of two-stage air-compressor driven by the crankshaft or gearbox shaft. It takes air from atmosphere, compresses it and delivers to the air reservoir through un-loader valve. Where the pressure of the reservoir reaches the maximum degree, the un-loader valve opens to the atmosphere. Then the compressed air is directed in to the atmosphere directly.

Each of the four wheels fitted with brake chambers consists of a diaphragm, and which the air pressure is applied and pushes it. This force operates the cam actuating lever and applies the brake. Each of the brake chamber is connected to the brake pedal, and air filter is also fitted between the brake valve and reservoir.

Working: When the brake pedal is pushed the brake valve opens and compressed air is allowed in to the brake chamber. The brake valve consists of three passages.

1. Air intake
2. Exhaust
3. Brake chamber

When the brake pedal is pressed the exhaust passage will be closed and Air intake passage open and compressed air goes back to the chamber. During return stroke the exhaust passage opens while intake closes and used air goes to the atmosphere. This system fitted with an emergency mechanical brake, which can be used when air supply fails the air brake system, which is called air assisted hydraulic braking system.



### Advantages:

1. This system used in heavy vehicles because they are more powerful than hydraulic or mechanical brakes.

2. It simplifies the chassis design
3. The compressed air is used for purposes like tyre inflation; for horn, windscreen wiper etc.

Disadvantage:

If there is any leakage in passage the entire system will be fail.  
Therefore sealing of air is very difficult.

**Short Answer Questions:**

1. Explain the function of brakes?
2. What are the requirements of Automobile brakes?
3. What are the classifications of brakes?
4. What does stopping distance mean?
5. Explain about braking efficiency?

**Long Answer Questions:**

1. What are the types of mechanical brakes explain any one of them?
2. Explain the construction and working of Hydraulic brakes?
3. Explain the Construction and working of Air brakes?

## CHAPTER-IV

### SUSPENSION SYSTEM:

**Introduction:** The automobile frame and body are mounted on the front and rear axle not directly but through the springs and shock absorbers. The assembly of parts, which perform the isolation of parts from the road shocks, may be in the forms of bounce, pitch and roll is called suspension system.

Functions of suspension system:

1. It prevents the vehicle body and frame from road shocks.
2. It gives stability of the vehicle.
3. It safeguards the passengers and goods from road shocks.
4. It gives the good road holding while driving, cornering and braking.
5. It gives cushioning effect.
6. It provides comfort.

**Requirements of suspension system:**

1. There should be minimum deflection.
2. It should be of low initial cost.
3. It should be of minimum weight.
4. It should have low maintenance and low operating cost.
5. It should have minimum tyre wear.

**Components of Suspension system:** Coil springs, Leaf springs, shock absorbers, Spring shackles, stabilizer

**Independent suspension system:** The independent suspension system means any arrangement that connects road wheels to the frame in which raise or fall of the wheel has no direct effect on the other wheel. It eliminates wheel wobbling.

**Advantages:** 1. It provides softer suspension.

2. It reduces wheel wobbling
3. It reduces the tendency of fitting of the wheel on one side due to road vibration
4. It provides more space for engine accommodation.
5. It promotes under steer which results low un sprung weight.
6. The movement of the spring on one wheel is not transmitted to the other wheel.

**Sprung Weight:** It is weight of all the parts supported by the spring including weight of the spring.

Un sprung weight: It is the weight of all the parts between the spring and rod and the portion of spring weight it self.

Basic suspension movements:

1. Bouncing: The vertical movement of the complete body.
2. Pitching: The rotating movement of all the parts between the spring and road and the portion of spring weight itself.
3. Rolling: The movement about longitudinal axis produced by the centrifugal force during cornering.

Types of front Independent suspension system: There are three types:

1. Wish bone Type
2. Vertical guide type
3. Trailing Link Type

Wish bone Type of Front Independent suspension system:

In this type of suspension system coil springs are mostly used between the two suspension arms and are controlled with frame and at the open ends of the upper and lower wishbones which are connected to the chassis frame. The upper arm is shorter than lower one. This keeps the wheel track constant. The closed ends of the both arms are connected with steering knuckle, supported by means of kingpin. A coil spring is placed in between the lower suspension arm and frame.

Types of suspension springs:

1. Steel Springs :
  - a. Leaf Springs
  - b. Coil Springs
  - c. Torsion bar Springs
2. Rubber Springs:
  - a. Compression Springs
  - b. Progressive Springs
3. Plastic Springs
4. Air Springs:
  - a. Bellow Type
  - b. Piston Type
5. Hydraulic Type

Construction and working of Leaf Springs:

Leaf springs are formed by bending. They are made of long strips of steel. Each strip is named as Leaf. The long leaf is called Master Leaf, and it consists of eyes at its both ends. One end is fixed to the chassis frame, the other end is fixed to the shackle spring. The spring will get elongated during expansion and shortened during compression. This change in length of spring is compensated by the shackle. The U-bolt and clamps are located at the intermediate position of the spring. The bronze or rubber bushes are provided on both eyes on the master leaf.

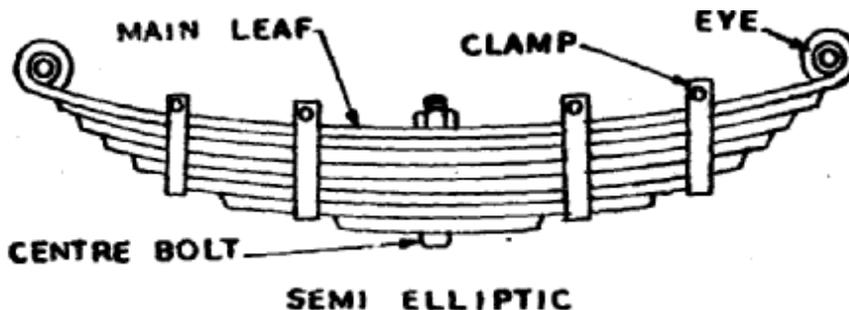
Types of Leaf Springs: There are five types of leaf springs

1. Full – elliptic type
2. Semi – elliptic type
3. Three Quarter – elliptic type
4. Transverse Spring type
5. Helper Spring type

#### 1. Full elliptic :

The advantage of this type is the elimination of shackle and spring. The lubrication and wear frequently which are on of the main draw back of this type of springs.

#### 2. Semi – elliptic :



This type is more popular for rear suspension are used in 75% of cars.

#### 3. Three – Quarter – elliptic type:

This type is rarely used in now-a-days. It gives resistance, but occupies more space than other types.

#### 4. Transverse Type:

This type of spring is arrange transversely across the car instead of longitudinal direction. The transverse spring for front axle as shown in figure,

which is bolted rigidly to the frame at the center and attached to the axle by means of shackle at both ends.

#### 5. Helper Springs:

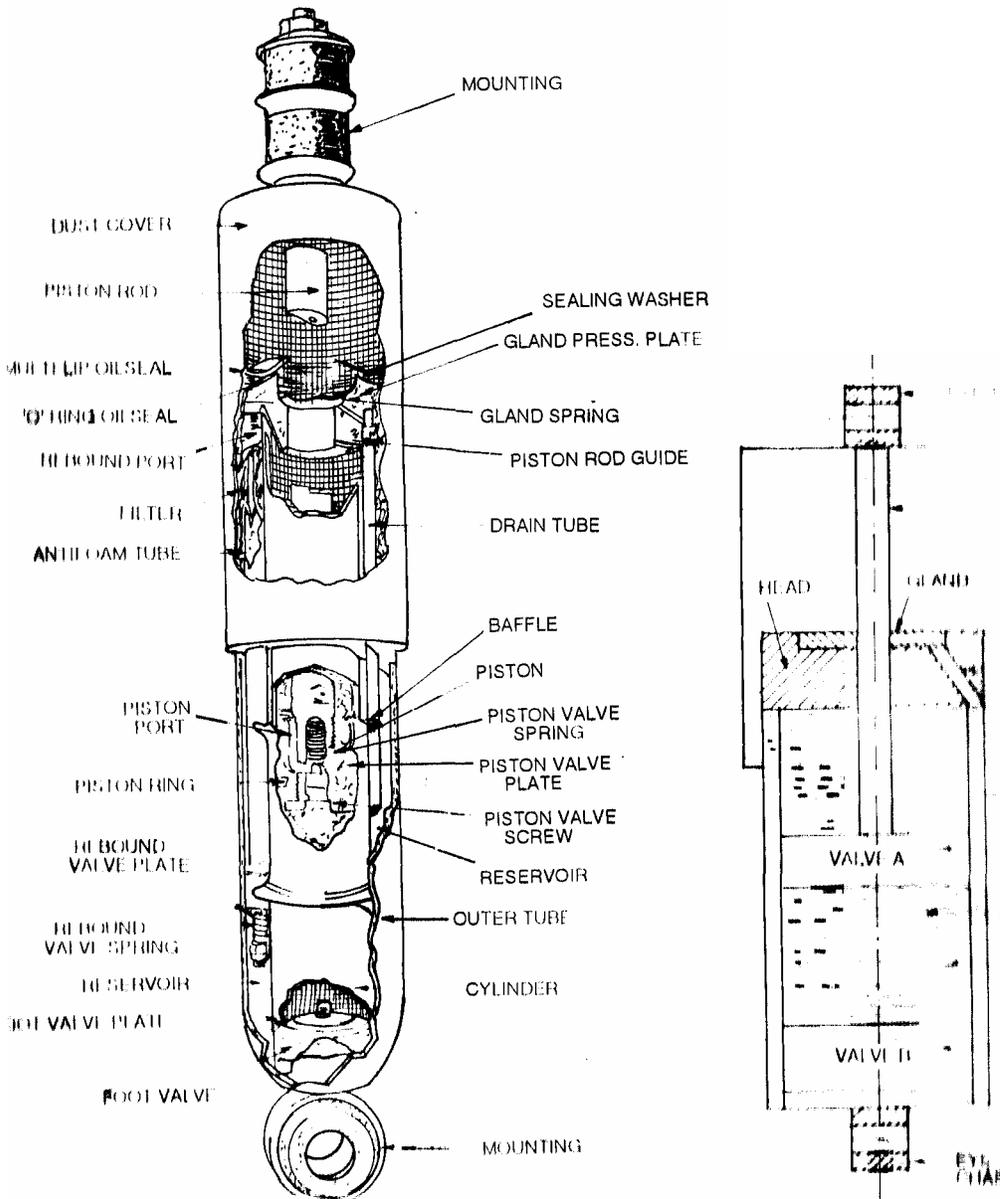
The helper springs are used in heavy vehicles for rear suspension. When vehicle fully loaded the main spring as well as helper spring come in action and absorb the road shocks. When the load of the vehicle is less the helper spring will not act and the main spring only absorb the road shocks.

**Need of Shock Absorber:** If the suspension springs are rigid enough, they will not absorb road shocks efficiently, and if they are flexible enough, they will continue to vibrate for longer time even after the bump has passed. Therefore, the springing device must be compromise flexibility and stiffness a shock absorber needed in Automobile Suspension system.

**Types of Shock Absorbers:** They are mainly two types

1. Mechanical.
2. Hydraulic –
  - a. Van type
  - b. Piston – i) Single Acting ii). Double Acting
  - c. Telescopic type

**Construction and Working of Single acting Telescopic hydraulic shock absorbers:**



The telescopic shock absorber consists of a cylinder to which a head is welded to screwed to the outer tube. The space between outer and inner tube is called reservoir. A pressed steel cap and axle eye by means of which cylinder is screwed to the axle are welded to the outer tube. A piston slides inside the cylinder and screwed to the piston rod at which its upper end of chassis eye, it is attached to the frame of the vehicle. The part of the piston rod that is outside of the cylinder is protected by a cover which is welded to the chassis eye. A piston rod gland packing prevent the leakage, when the piston passes through the head and any fluid is trapped by it is supplied to the reservoir through drain hole.

Working: If the axle eye moves upwards then the fluid must be displaced from the bottom. Top side of the bottom side fluid through the outer ring of the piston by lifting the non return valve. But since the increase in the volume of upper end of the cylinder is less than the volume of the lower end. Fluid will also be displaced through the inner ring of holes of non return valve of foot valve, and the level of the fluid will raise in the reservoir. The pressure setup will depend on the size of hole in the piston and Foot valve and the square of the speed of which the cylinder is moved.

For downward motion of the cylinder the fluid will be displaced from the upper end of the piston. In the lower end through the inner ring of hole of non return valve in the piston. The fluid will also be drawn in the lower end of the cylinder from the reservoir to the outer ring of hole of non return valve of the foot valve.

Fig of shock absorber

### **Stabilizer Bar:**

Stabilizer is necessarily used in all independent front suspension. It reduces the tendency of the vehicle to roll on either side when taking a turn. It is simply a bar of alloy steel with arms at each end connected to the lower wishbone of the independent suspension system. It is supported in bush bearings fixed to the frame and is parallel to the cross member. When both the wheels deflect up or down by the same amount, the stabilizer bar simply turns in the bearings. When only one wheel deflects, then only one end of the stabilizer moves, thus it acts as a spring between two sides of the independent front suspension.

### **Torsion Bar**

Torsion bar suspension is used in independent suspension system. It is a rod acting in torsion and taking shear stresses only. It is made up of heat treated alloy spring steel. This bar stores an amount of energy nearly as same as coil spring.

The bar is fixed at one end to the frame, while the other end is fixed to the end of the wheel arm and supported in the bearing. The other end of the wheel arm is connected to the wheel hub. When the wheel strikes a bump, it starts vibrating up and down, thus exerting torque on the torsion bar which acts as a spring.

### Short Answer Questions

1. Explain the functions of suspension system?
2. List out the requirements of suspension system?
3. What are the types of suspension springs?
4. what are the basis suspension movements?
5. Explain about sprung weight and un sprung weight?

### Long Answer Questions

1. What are the types of Independent suspension system and explain about wish bone type of front independent suspension?
2. What are the types of leaf spring used in automobiles and explain with neat sketches?
3. Explain the construction and working of single acting, telescopic, hydraulic shock absorber with a neat sketch?
4. Explain briefly about following contents:
  - a. stabilizer bar
  - b. Torsion bar

## CHAPTER – V

### SEAT DOOR AND WINDOW MECHANISM OF CAR BODY

Construction and working of door lock mechanism:

There are different methods to door lock or unlock mechanisms:

1. With a key
2. By pressing the unlock button inside the car
3. By using the combination lock on the outside of the door
4. By pulling up the knob on the inside of the door.
5. With a keyless – entry remote control.
6. By a signal from a control center.

In most of the cars having power door locks, the lock/unlock switch actually sends power to the actuators that unlock the doors. But in more complicated system having several ways to lock and unlock the doors, the body controller decides when to do the unlocking. Body controller is a computer in the car. Besides locks it takes care of many little things that makes your car friendlier e.g., it make sure the interior lights stay on until the car is started, it beeps if you leave your head lights on or leave the key in the ignition. Etc., In power locks, body controller monitors all the possible sources 'lock' or 'unlock' signals e.g. it monitors a door – mounted touch pad and unlock the doors when the correct mode is entered, it monitors a radio frequency and unlocks the doors when it receives the connect digital code from the radio transmitter in the key fob and also monitor the switches inside the car. When it receives a signal from any of these sources, it provides power to the actuator that locks or unlocks the doors.

The detailed power lock mechanism, in the door the actuator is portioned bellow the latch. A rod connects the actuator to the latch and another rod connects the latch to the knob that sticks up out of the top of the door. When the actuator moves the latch up, it connects the outside door handle to the opening mechanism. When the latch is down the outside door handle is disconnected from the mechanism so that the door cannot be opened. To unlock the door, the body controller supplies power to the door-lock actuator for a timed interval. The door lock actuator is a simple device. It consists of a small electric motor which turns a series of spur gears that operate a rack. The rack pulls the knob up or pushes it down, thus opening or closing the lock.

Construction and Working of Manual Window Regulating Mechanism:

The window glass winding mechanism included in the door construction. When the handle is turning one direction, the toothed quadrant which in turn moves the window carnivore. The glass fitted on the window carrier which moves up and down as per the direction of rotation of the toothed quadrant either clock wise or anti clock wise.

Construction and Working of Seat Adjusting Mechanism:

It is different form from the passenger seat . Bucket tupe of seat commonly used. This type of seat is adjustable towards or away from the steering wheel or control pedals in order to suit driver's varying lengths of the legs. In this arrangement rails are fixed to the frame. Frame is fixed with bolts to slide on a rails squire to the floor. A lever projected to laterally to the seat cushion. This engages with slide catch for seat position adjustment. The return spring of the rocker again engages with the side catch. The lever is left free after the adjustment of seat.

### Short Answer Questions

1. What are the different methods of door lock/unlock mechanism?

### Long Answer Questions

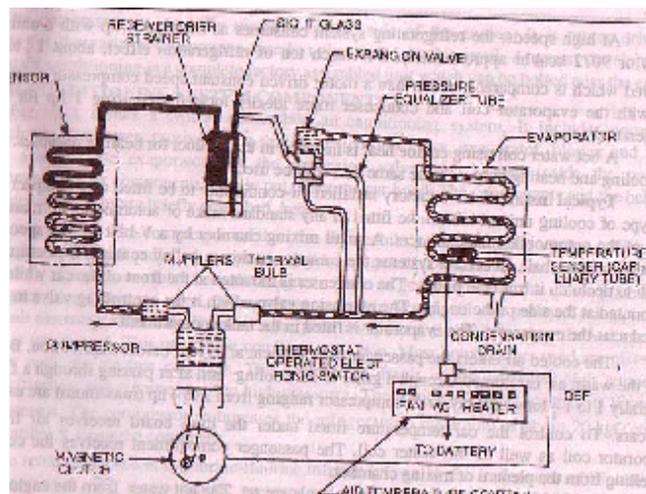
1. Explain the construction and working of door lock mechanism with a neat sketch?
2. Write the construction and working of Manual Window regulating mechanism with neat sketch?
3. Explain about construction and working of power window regulating mechanism?
4. Explain the construction and working of seat adjusting mechanism?

## CHAPTER – VI

### AIR CONDITIONING OF MOTOR VEHICLE:

**Necessity of Automobile Air-Conditioning:** Due to varying conditions of heating, ventilating, cooling, dehumidification in the atmosphere at various places, it is necessary to be conditioned the air in the automobiles. To maintain human comfort and improve internal atmosphere in an enclosed space, proper control of freshness temperature, humidity and cleanliness of air is required. For this reason Automobile air-conditioning is necessary in the vehicles.

**Construction and working of Passenger car Air – Conditioning:**



The main components of Auto Air- Condition are:

1. Compressor
2. Magnetic clutch
3. Condenser
4. Receiver or dehydrator
5. Expansion valve
6. Evaporator
7. Such on throttling valve

**Compressor:** The compressor in the Auto Air- Condition system is belt-driven engine crankshaft pulley. A magnetic clutch engages the compressor shaft. When the voltage is applied to the compressor clutch coil was sufficient the compressor and pulley rotates together as one unit. When the voltage is

interrupted the pulley, disengages automatically, causes compressor to stop. The low – pressured, high temperature, vaporized refrigerant enter in to the compressor and it increases the pressure of about  $20\text{kg/cm}^2$  and  $100^\circ\text{c}$  temp, and pushes into the condenser. In the compressor the refrigerant never reaches its liquid state.

**Magnetic Clutch:** The electrically controlled magnetic clutch is housed in pulley assembly and a switch is on the controlling panel. This clutch is engaged or disengaged depending upon the temperature of the air. Bellow  $40^\circ\text{F}$ . The compressor cannot be operated. Above  $55^\circ\text{F}$  this switch closes and completes the circuit to the compressor clutch.

**Condenser:** It is usually placed in front of the car and it is looks like a Fin-and-tube radiator. The condenser receives heated and compressed gas from the compressor and is cooled by the air passing across the condenser. The refrigerant now in the form of high pressure liquid which is fed in to the receiver drier Unit.

**Reservoir or Dehydrator:** The refrigerant stored under pressure in the Receiver-drier. The drier removes any traces of moisture present in the system to avoid freezing of moisture at low temperature and thus clogging the lines. It causes running troubles.

**Expansion Valve:** In the expansion valve high pressure liquid is converted into low pressure liquid then the refinement flow in to the evaporator

**Evaporator:** The evaporator unit where the cooling effect is obtained is usually located inside the passenger compartment bellow the dash board. A high capacity blower circulates the air in the in the car interior across the evaporator coils, and the drops the temperature of the air inside the passenger compartment. The heat picked by the refrigerant goes back to the compressor in the vapour form, where the refrigerant is again compressed to a high pressure and the cycle starts again.

**Suction throttle valve:** It ensures that the refrigerant the evaporator stays at such a pressure that the evaporator core surface temperature does not fall bellow the freezing point of water ( $0^\circ\text{c}$ ), thus preventing ice formation in the evaporator.

Short Answer Questions :

1. What is the necessity of automobile air-conditioning?

Long Answer Questions:

1. Write the construction and working of automobile Air-conditioning system with a line diagram?

## CHAPTER –VII PAINTING OF AUTOMOBILE

**Introduction:** The corrosive nature of a metal used in a motor body construction, necessitate the application of an anti corrosion coating. For this reason the painting should be done.

Function of Painting:

1. It reduces the corrosion and protect the vehicle body.
2. It is used for cleanliness.
3. It is used for esthetic appearance.
4. It is used to reduce the friction due to the aerodynamic drag and allow the vehicle in stream lining.
5. It is used for identification purpose.

Requirements of Good Painting:

1. It should be anticorrosive nature.
2. It should protect the hidden parts also from the corrosion.
3. It should have esthetic appearance.
4. It should be smooth finish for stream lining.
5. It must reduce the aerodynamic drag.

Main Constituents of paints:

1. Pigments
2. Drying oil
3. Thinners
4. Dry Extenders
5. Plasticizers
6. Resins.

Reason for failures of paints:

1. Not proper cleaning of body before painting
2. Not covering dents or spots.
3. Not using of proper good quality paint
4. Not applied the pretreatment with zinc phosphate

Different Types of Painting

1. Spray paint
2. Hand paint

Spray Painting procedure: Now-a-days spray paintings are largely use. The procedure is as follows:

1. First of all the old paint should be scrapped with the help of scrappers
2. If there is nail or any obstruction they will be removed with the help of pincers
3. The removal of old paint must be by application of caustic soda solution and spirit solutions.
4. In some portions heating is necessary with the help of blow lamp for removal of old paint.
5. The surface should be cleaned from dirt, dust, rust, grease etc.
6. The surface should maintain perfect level from any kind of bends.
7. Then once again clean with red oxide.
8. After wards duco paints or delux paints or required colour may be sprayed on the vehicle as the primary coating.
9. After first coating is over we must see the variations of the surface clearly and apply second coating and it will finish the painting job and gives beautiful appearance.
10. Then decoration and letter writing finishes the body paint.
11. Finally polish the vehicle thoroughly.

Short Answer Questions:

1. What are the functions of painting in Automobile body?
2. Explain the requirements for good painting?
3. What are the main constituents of paints?
4. What are the reasons for failure of the painting?

Long Answer Questions:

1. What are the different types of painting methods and explain the procedure of spray painting?

## CHAPTER – VIII

### AUTOMOBILE POLLUTION

**Introduction:-** The major source of air pollution are flue gases, emissions from refineries and factories etc.

on one hand and 60% of air pollution are due to automobile exhaust emission in other hand. The I. C Engine exhaust contains several pollutants in the form of oxides of Nitrogen (Nox) which are toxic and facing severe criticism. If the concentration exceeds 100 ppm in enclosed space, it may even cause death.

Effects of automobile pollution on environment and human beings:

The Oxides of Nitrogen together with hydro carbons react in the presence of sunlight and form

Polto chemical smog. It effects the bad condition on crops

Animals, Birdscracking in rubber etc.

It Causes eyes irritation, objectionable odour.

It causes reduction in visibility, results traffic hazards.

The soot particles in the exhaust gases settle down on buildings and trees if may thus spoils appearance of buildings in the long run.

The exhaust smoke is dangerous for health and causes troubles in breathing Problems.

Types of Automobile emissions:

The vehicle emissions contains following types of pollutants

Exhaust emissions

Carbon Monoxide

Un burnt hydro carbons

Oxides of Nitrogen

Lead oxides

Sulphur dioxide

Smoke

Evaporative Emissions

Carburettor

fuel tank

petrol bunks

Crank case blow by from the crank case hydro carbons are emitted

Measurement of Percentage of Pollutions from petrol and Diesel Vehicles with the help of exhaust gas analyzers

By using exhaust gas analyzer the measurement of percentage of following pollutants from petrol and Diesel Vehicles

Pollutant Constituents	Petrol Engine				Diesel Engine			
Carbon Monoxide%	9.9	2.9	2.7	3.9	-	0.01	-	-
Hydro Carbons %	0.53	0.16	0.1	1.00	0.04	.001	0.01	0.03
Oxides of Nitrogen PPM	30	1.020	650	20	60	8.5	240	30
Aldehydes PPM	30	30	10	290	10	20	10	30

Treatment of Exhaust gases by using catalytic converter

Fig Flow of gas through catalytic converter

The exhaust gases from the engine are passed through CATALYTIC CONVERTER as shown in fig.,

A catalytic converter is a cylindrical unit about the size of small silencer and it is installed in to the exhaust system of a vehicle. It is placed between the exhaust manifold and silencer in the exhaust system of a vehicle. Inside the converter there is a honey corn structure of a ceramic or metal . Which is coated with aluminum base material and there after a second coat of precious metals platinum, palladium or rhodium or combination of the same. The second coating serves as a catalyst. A catalyst is a substance which causes a chemical reaction that normally does not happen in to the given conditions. As a result catalytic reaction as the exhaust gases pass over the

converter substance, toxic gases such as CO, HC and NOX are converted into harmless CO<sub>2</sub>, H<sub>2</sub>O and N<sub>2</sub>. There are two types of catalytic converters

A Two way converter which is used to control only CO and HC emissions by oxidation

A Three way converter Which is used almost in all petrol cars. It controls CO and HC by oxidation

As well as NOX by reduction.

Short answer Questions:

What are the effects of automobile pollution on environment and human beings ?

What are the types of Automobile emissions?

Long answer Questions:

Explain the treatment of Exhaust gases by using catalytic converters with a neat SKETCH?

## CHAPTER IX

### LEGAL ASPECTS OF MOTOR VEHICLES:

Introduction: The motor vehicle act of 1977 is applicable and extends to the whole of India. It was framed in 1939 and amended time to time according to the requirements and necessities of roads and vehicles. This act as amended up to 1977 has 10 chapters, 135 sections and 12 schedules.

The 10 Chapters as follows:

Chapter I – Preliminary Section 1-2.

Chapter II – Licensing of driver of motor vehicles (Sections 3-21)

Chapter IIA - Licensing of conductors of state carriage (Sections 21A-21J)

Chapter III – Registration of motor vehicles (Sections 22-41)

Chapter IV – Control of transport vehicles (Sections 42-68)

Chapter IVA – Special provisions relating to state transport undertaking (Sections 68A-68J )

Chapter V – Construction, equipment and maintenance of motor vehicles (Sections 69-70)

Chapter VI- Control of traffic (Sections 71-91)

Chapter VII - Motor Vehicles temporarily leaving or visiting India (Section 92)

Chapter VIII – Insurance of motor vehicle against third party Risk (Section 93-111A)

Chapter IX – Offences, penalties and procedure (Section 112-132)

Chapter X – Miscellaneous (Section 132A-135)

The Schedules are as follows:

First Schedule - Forms

Second Schedule I – Diseases and disabilities absolutely disqualifying a person for obtaining a license to drive a motor vehicle

II – Diseases and disabilities absolutely disqualifying a person For obtaining a license to drive Public vehicles.

Third Schedule - Test of competence to drive

Fourth schedule - Authorities entitled to grant Licenses to drive and to register the motor vehicles, the temporary or time being under the exclusive control of the central Government and Registration makes for such vehicles.

Fifth Schedule - Offences on connection of an endorsement shall be Made on the licence of the person affected

Sixth Schedule - Registration marks

Seventh Schedule - (omitted)

Eighth Schedule - Limits of speed for motor vehicles  
Ninth Schedule - Traffic signs  
Tenth Schedule - Driving Regulations  
Eleventh Schedule - Signals  
Twelfth Schedule - Repeat of certain enactments

### **Traffic Signals :**

#### **Signals:**

1. When about to turn to the Right or to drive to the Right hand side of the road in order to pass another vehicle or for any other purpose, a driver shall extend his right arm in a horizontal position outside of and to the right of his vehicle with the palm of the hand turned to the front.
2. When about to turn to the left or to drive the left hand side of the road, a driver shall extend his right arm and rotate in an anti-clockwise direction.
3. When about to slow down, a driver shall extend his Right arm with the palm downwards and to the right of the vehicle and shall move the arm so extended up and down several times in such a manner that the signal can be seen by the driver of any vehicle which may be behind him.
4. When about to stop, a driver shall rise his right Forearm vertically outside and to the right of the vehicle, palm to the front.
5. When a driver wishes to indicate to the driver of a vehicle behind him that he desires that driver to overtake him, he shall extend his right arm and hand horizontally outside of and to the right of the vehicle and swing arm backwards and forwards in a semi-circular motion.

Registration Requirements : According to Chapter III section 22 to 28 the following are the registration requirements

#### **Section 22: Necessity for Registration:**

No person shall drive any motor vehicle and no owner of a motor vehicle shall cause or permit the vehicle to drive in any public place or in any other place for the purpose of carrying passengers or goods unless the vehicle is registered in accordance with this chapter and certificate of registration of the vehicle has not been suspended or cancelled and vehicle carries a registration mark displayed in the prescribed manner.

How to make Registration? What are the Requirements : Chapter III section 24.

1. An application by or on behalf of the owner of a motor vehicle for registration shall be in Form E as set forth in the first schedule, shall contain the information require by the Form, and shall be accompanied by the prescribed fee.

Provided that where a motor vehicle is jointly owned by more persons than one, the application shall be made by one of them behalf of all the owners and such applicant shall be deemed to be the owner of the motor vehicle for the purposes of this Act.

2. The Registration authority shall issue to the owner of a motor vehicle registered by it a certificate of registration in Form- 'G' as set forth in the First Schedule and shall enter in a record to be kept by particulars of such certificate.

3. The registration authority shall assign to the vehicle, for display there on in the prescribe manner, a distinguishing mark (in the Act referred to as the registration mark) consisting of one of the groups or letters allotted to the state by the sixth schedule followed by a number containing not more than four figures

Necessity of Permits for Commercial Vehicles: According to Chapter IV section 42

1. No owner of transport vehicle shall use or permit the use of the vehicle in any public place, ( whether or not such vehicle is actually carrying any passenger or goods) save in accordance with the conditions of a permit granted or countersigned by Regional or State Transport Authority or the commission authorizing the use of the vehicle in the place in the manner in which the vehicle is being used.

Provided that a stage carriage permit shall subject to any conditions that may be specified in the permit, authorize the use of the vehicle as a contract carriage.

Provided further that stage carriage permit may subject to any conditions that may be specified in the permit, authorize the use of the vehicle as a goods vehicle either when carrying passengers or not

Provided further that a public carrier's permit shall subject to any conditions that may be specified in the permit authorize the holder to use the vehicle for the carriage of goods for or in connection with a trade or business carried on by him.

2. In determining for the purpose of chapter IV whether the transport vehicle is or is not used for the carriage of goods for hire or reward.

a. The delivery or collection by or on behalf of the owner of the goods sold, used or let on hire or hire purchase in the course of any trade or business carried on by him other than the trade of business of providing transport.

b. The delivery or collection by or on behalf of owner if the goods which have been or which are to be subjected to a process or treatment in the course of trade or business carried on by him.

c. The carriage of goods in a transport vehicle by a manufacture or agent or order in such goods while the vehicle is being used for demonstration purpose, shall not be deemed to carrying of the goods for hire or reward, but the carriage in a transport vehicle of goods by a person not being a dealer in such goods who has acquired temporary ownership of goods for the purpose of transporting them to another place and their relinquishing ownership shall be deemed to constitute a carrying of goods for hire or reward.

INSURANCE COVERAGE: Chapter VIII section 93 and 94

a. Authorized insurance means an insurance in whose case the requirements of the insurance Act, 1938(IV of 1938), the complied with;

b. "Certificate of Insurance" means a certificate issued by the authorized insurer in persuade of sub – section(4) of section 95 and includes a cover note complying with such requirement as may be prescribed, and where more than one certificate has been issued in connection with a policy, or where a copy, as the case may be;

c. Property includes roads, bridges, culverts, causeways, trees, pots and milestones.

d. " Reciprocating country" means any such country as may be on the basis of reciprocity be notified by the central government in the official Gazette to be a reciprocating country for the purpose of this chapter

e. "Third Party" includes the government.

Necessary for insurance against third party risk:

1. Not person shall use except as a passenger or cause or allow any other person to use a motor vehicle in public place, unless there is in force in relation to the use of vehicle by the person or that other person as the case may, be a policy of insurance complying with the requirement of this chapter.

Explanation: A Person driving motor vehicle merely as a paid employee, which there is in force in relation to the use of the vehicle no such policy as is required by this sub section, shall not be deemed to act in contravention of the sub section unless he knows or has reason to believe that there is no such policy in force.

2. sub section (1) shall not apply to any vehicle owned by the central government of a state government and use for Government purpose un connected with any commercial enterprises.
3. The appropriate Government may be order exempt from the operation of subs section (1) any vehicle owned by any of the following authorities namely.
  - (a) the Central Government or a State Government if the vehicle is use for Government purpose connected with any commercial enterprise.
  - (b) any local authority
  - (c) any state Transport undertaking within the meaning of section 68 – A

Provided that no such order shall be made in relation to any such authority unless a fund have been established and is maintained by the authority in accordance with rules made in that behalf under this act for meeting any liability arising out of the use of any vehicle of that authority which that authority of any person in its employment may incur to third parties.

Explanation For the purpose of sub-section appropriate Government means the central Government or the State Government as the case may be and

- (1) In relation to any corporation or company owned by the Central Government means that Central Government or that State Government.

- (ii) In relation to any corporation or company owned by the Central Government or one or more State Governments means the Central Government
- (iii) In relation to any other State Transport undertaking or any local authority means the Government which has control over the undertaking or authority.

#### PROCEDURE FOR OBTAINING DRIVING LICENCE:

According to Chapter II Section 3 to 9

Section 3: Necessity of driving License: No Person shall drive a motor vehicle in any public

Place unless he holds an effective driving License issued to himself authorizing him to drive the vehicle .

Section 4: No person under the age of eighteen years shall drive a motor vehicle in any public place.

Section 5 No owner or person in charge of a motor vehicle shall cause or permit any person who

Does not satisfy the prohibition of Section 3 or Section 4 to drive the Vehicles

Section 6 No holder of driving license shall permit it to be used by any other person.

Section 7 Grant of Driving License

(i) Any person who is not disqualified under section 4 for driving a motor vehicle and who is not for the time being disqualified for holding or obtaining a driving License may apply to licensing authority having jurisdiction in the area.

(ii) In which he ordinarily resides or carries on business

(iii) In which the school or establishment where he is receiving or has received instruction in driving a motor vehicle is situated or

(iv) If the application is for a driving license to drive a paid employee in which the employer resides or carries on business for the issue to him a driving license.

2. Every application under sub section (1) shall be in a Form 'A' as set forth in the First Schedule. It shall be signed by or bear the thumb impression of

- the applicant in two places, and shall contain the information required by the Form.
- 3 When the application is for a driving license to drive a paid employee or to drive a transport vehicle, or where in any other case the licensing authority for reason to be stopped in writing so requires certificate in Form 'C' as set forth in the First Schedule signed by a registered medical Practitioner.
- 4 Every application for a driving license to drive a paid employee and every application for a driving license to drive a transport vehicle shall be accompanied by three clear copies of recent photograph of the applicant.
- 5 If, from the application or from the medical certificate referred to in sub section 3, it appears that the applicant is suffering from any disease or disability specified in the second Schedule or any other disease or disability which is likely to cause the driving by him of a motor vehicle of the class which he would be authorized by the driving license applied for to drive to be source of danger to the public or passengers the licensing authority shall refuse to issue the driving license.
- 6 A driving license shall be issued to any applicant unless he passes to the satisfaction of the Licensing authority the test of competence to drive specified in Third schedule.
- 7 The test of competence to drive shall be carried out in a vehicle of the type to which the application refers, and for the purposes of part I of the test.
- (a) A Person who passes the driving test in driving heavy motor vehicle shall be deemed Also to have passed the test in driving any medium motor vehicles or light motor vehicles.
- (b) A Person who passes the test in driving a medium motor vehicle shall be deemed also to have passed the test in driving any light motor vehicles.
- 8 When application has been duly made to the appropriate licensing authority and the applicant has satisfied such authority of his physical fitness and of his competence to drive and has paid to the authority such fee as the central Government may by rules made under this Act. Specific the licensing authority shall grant the applicant a driving license if he is disqualified under section 4 for driving a motor vehicle or is for the time being disqualified for holding or obtaining a driving license.

## Long answer Question

1. What are the different traffic signals and signals?
2. What are the requirements for registration?
3. What are the necessity permits for commercial Vehicles ?
4. Explain about insurance coverage for a License?
5. What are the procedure for obtaining driving License?