



QUESTION BANK OF CHAPTER – 3

AUTOMOBILE CONTROL SYSTEMS

Program Name: Diploma in Mechanical Engineering

Program Code: ME

Name of Subject & Code : Automobile Engineering (315372)

Semester : FIFTH

Instructions: (1) Illustrate your answers with neat sketches wherever necessary.

Q.1.	Two marks questions.	Previous Exam	CO PO Mapping
1.	Enlist types of steering system used in Automobile	W25-1.d	C03-TL03.7-R
2.	State the function of Braking System. Enlist requirement of brake.	S24-1.d W24-1.c	C03-TL03.1-R
Q.2.	Four marks questions.	Previous Exam	CO PO Mapping
1.	Explain with neat sketch disc brake system	W25-2.c	C03-TL03.2-U
2.	Compare Disc brake and drum brake system	W25-3.b S26-3.b	C03-TL03.4-A
3.	With block diagram explain concept of ABS.	W25-4.c	C03-TL03.5-U
4.	Define with neat sketch in detail. i) Camber ii) Caster iii) King pin inclination iv) Toe-in v) Toe-out	W25-4.e S25-1.c S26-1.f	C03-TL03.8-R
5.	With neat sketch explain construction working, application of Rack and Pinion steering type gearbox system.	W25-6.c S25-3.b	C03-TL03.7-U
6.	Describe pneumatic braking system with neat sketch and state its advantages.	S26-6.a S25-5.b	C03-TL03.2-U
7.	State the requirements of steering systems.	S26-2.b	C03-TL03.6-R
8.	Explain construction and working of master cylinder.	S25-2.c	C03-TL03.3-U
9.	Explain with neat sketch of drum brake.	S24-4.b	C03-TL03.2-U
10.	Explain with neat sketch hydraulic braking system.	S24-3.b	C03-TL03.3-U
11.	State the classification of brakes.		C03-TL03.2-R



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12.	Explain with neat sketch recirculating ball type steering gear box.		C03-TL03.7-U
13.	Explain with neat sketch power steering.		C03-TL03.7-U
* **Best of Luck** *			


24/7/26

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Chapter 3: Automobile Control System,

3.1 Braking System: function & Braking Requirements, Classification of Brakes, Construction & working of Drum & Disc Brakes, Working of Mechanical, Hydraulic & Air Brake System.

* Braking System:-

It is used to reduce speed or stop the vehicle by converting kinetic energy into heat energy.

* Functions of braking system -

- To stop the vehicle safely
- To control speed while driving
- To hold the vehicle stationary (parking brake)
- To avoid accidents.

* Braking Requirements -

A good braking system must satisfy:

- High efficiency (Quick stopping).
- Uniform braking on all wheels.
- No skidding
- Minimum wear & tear.
- Good heat dissipation.
- Reliability & durability.
- Easy operation & maintenance.

* Classification of Brakes :-

1. According to Purpose

- a) Primary or service brake
- b) Secondary or parking brake.

2. According to location

a) At the transmission,

b) At the wheel

i) Two wheeler brake

ii) Four wheeler brake.

3. According to method of actuation

a) Mechanical brake

b) Hydraulic brake

c) Electrical brake

d) Vacuum brake

e) Air or pneumatic brake.

4. According to application

a) Foot brake

b) Hand brake

5. According to construction

a) Disc brake

b) Drum brake

6. According to extra braking effort.

a) Servo-brake or power assisted brake

b) Power brake or power operated brakes.

* Mechanical Brake System-

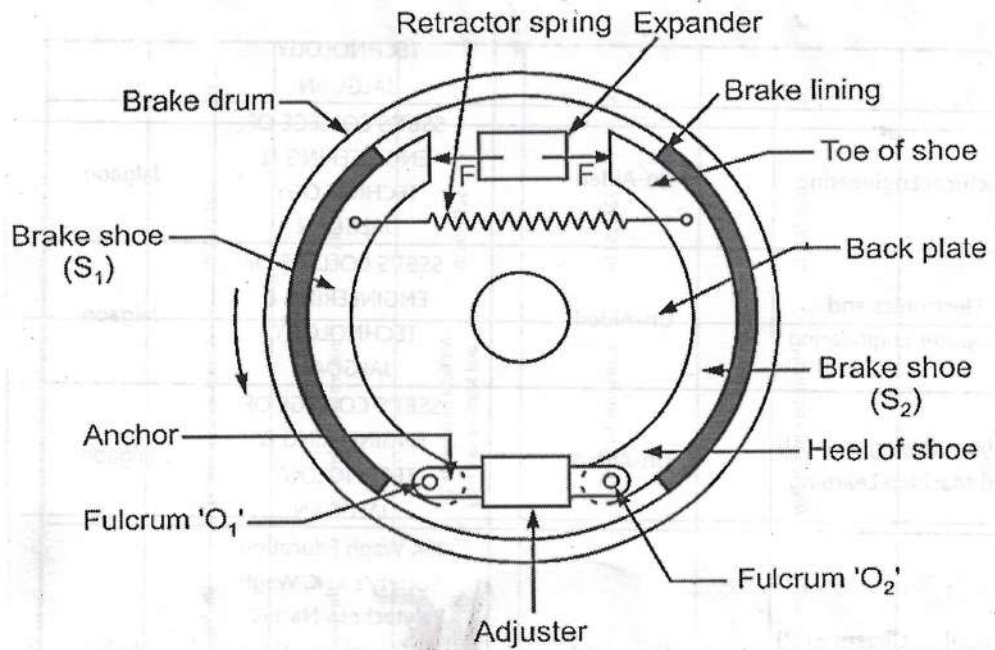
1. Hand Brake or parking brake

2. Drum brake

3. Disc brake

4. Girling brake.

* Drum Brake :-



* Construction -

- Brake drum - A circular drum attached to the wheel hub, rotates with the wheel.
- Brake shoes - Two curved metal shoes with friction lining on outer surface.
- Wheel cylinder - Contains pistons that push the brake shoes outward (in hydraulic brakes).
- Return springs - Pull back the brake shoes after braking.
- Backing plate - supports all components & is fixed to axle.
- Adjuster Mechanism - Maintains proper clearance betⁿ shoe & drum.

* Working -

- It works on the principle of friction betⁿ brakeshoe & rotating drum.
1. Brake Pedal Pressed - Hydraulic pressure is generated in the master cylinder
 2. Force Transmission - Pressure reaches the wheel cylinder.
 3. Expansion of shoes - Piston push brake shoes outward.
 4. Friction Generation - shoes press against inner surface of rotating drum.

5. Braking action - friction reduces speed & ~~brake~~ stops the wheel.
6. Brake Release - Return springs pull shoes back when pedal is released.

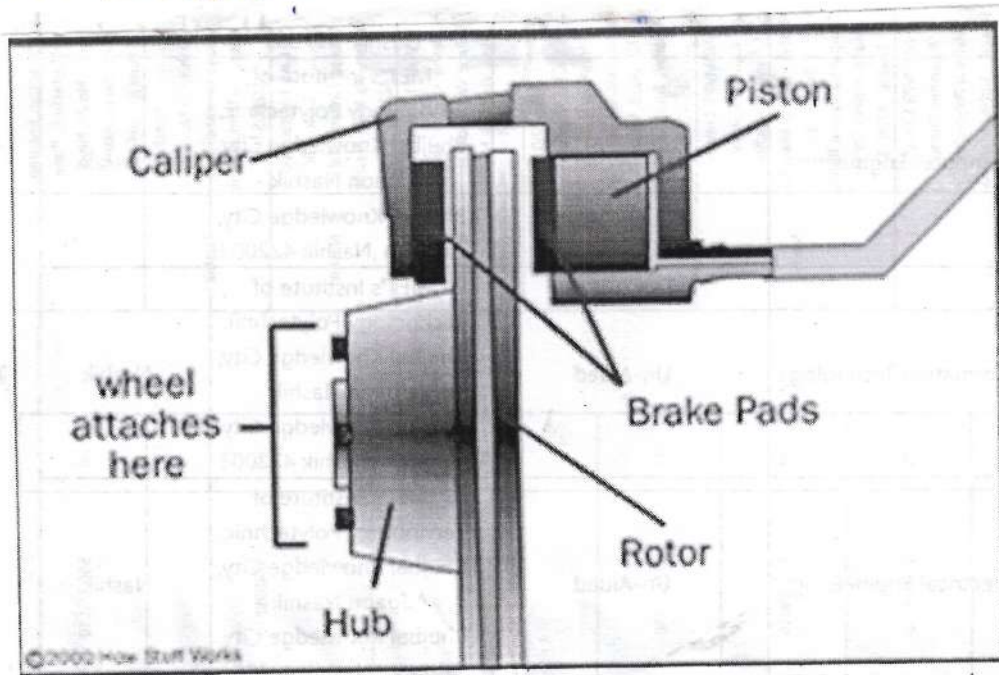
• Advantages -

- Simple construction, Low cost
- Good for parking brake

• Disadvantages -

- Poor heat dissipation
- Brake fading at high temp.
- Less efficient than disc brake.

* Disc Brake :



Construction -

- Brake Disc (Rotor) - attached to wheel & rotates with it.
- Caliper - housing that holds brake pads.
- Brake pads - friction material on both sides of disc
- Hydraulic piston - pushes pads towards disc.

Working -

- When brake pedal is pressed - hydraulic press. is generated.
- Pressure move the piston in caliper.

- Brake pads clamp the rotating disc.
- Friction slows down & stop the wheel.
- On releasing pedal $\rightarrow$ pad move back slightly.

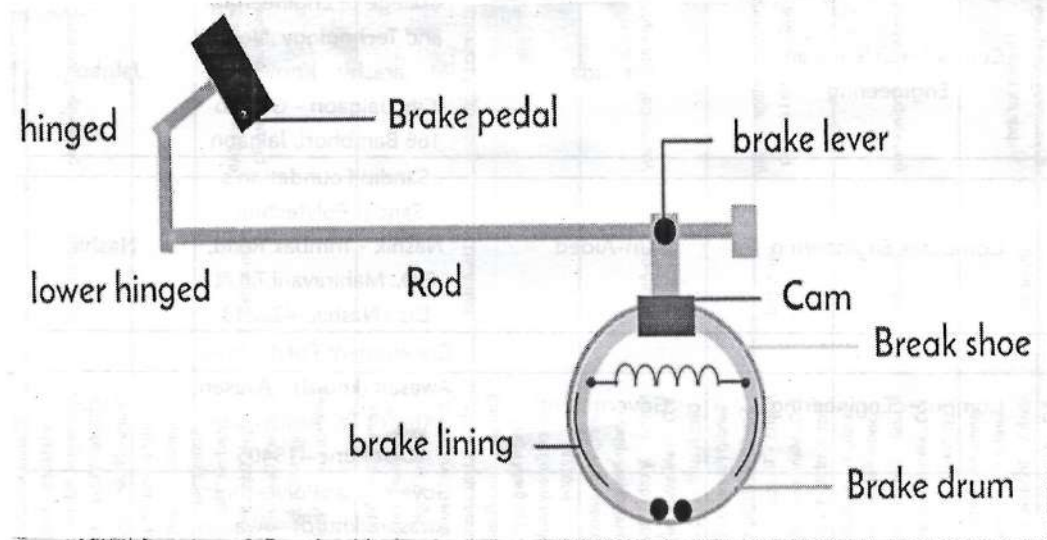
• Advantages -

- Better braking efficiency
- Less heat fading/brake fading
- Quick response.

• Disadvantages -

- Higher cost, require more maintenance
- Not effective as parking brake alone.

* Mechanical Braking System :-



Construction -

- Brake pedal - operated by driver.
- Rods, lever & Linkages - transmit force mechanically.
- Cables - flexible connection (used in hand brake)
- Brake shoes & Drum - produce friction.

Working -

1. Driver presses brake pedal.
2. Force is transmitted through rods & lever.
3. This force expands brake shoes.
4. Shoes press against drum.
5. Friction slows / stops the vehicle.

6. On release $\rightarrow$ Springs pull shoes back.

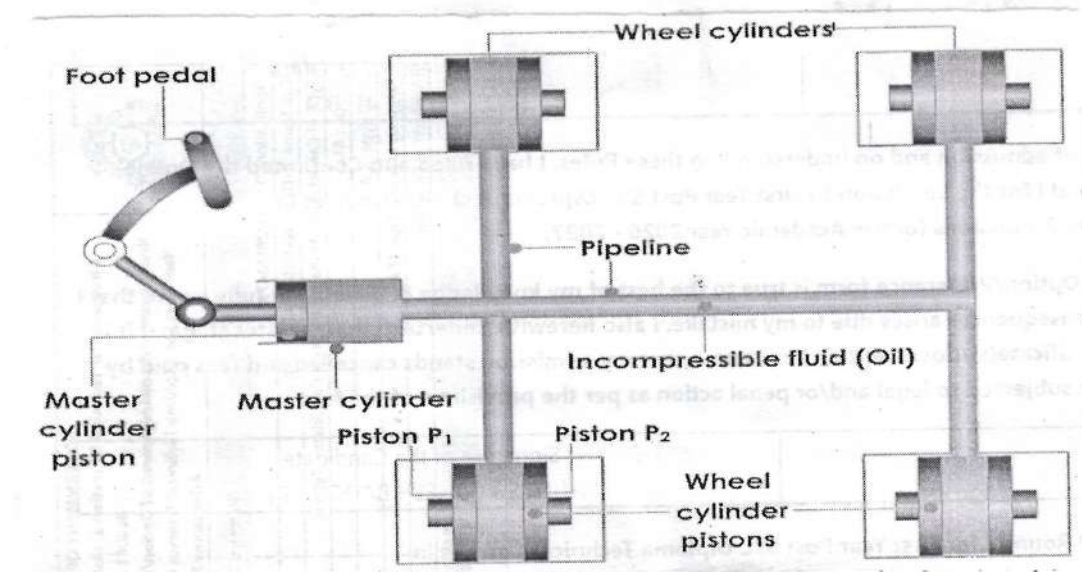
Advantages -

- simple & low cost, Easy maintenance,

Disadvantages -

- Unequal braking
- More wear & less efficiency.

* Hydraulic Braking System:



Construction -

- Brake pedal
- Master cylinder - generates hydraulic pressure
- Brake fluid - transmits pressure
- Brake Pipes / Lines
- Wheel cylinder / Caliper
- Brake Shoes / Pads.

Working -

1. Pressing pedal $\rightarrow$ master cylinder creates pressure.
2. Pressure transmitted through brake fluid (Pascal law)
3. Fluid reaches wheel cylinder / caliper.
4. Pistons push shoes / pads against drum / disc.
5. Friction slows / stops the wheel.
6. Release pedal $\rightarrow$ pressure reduces & brakes disengage.

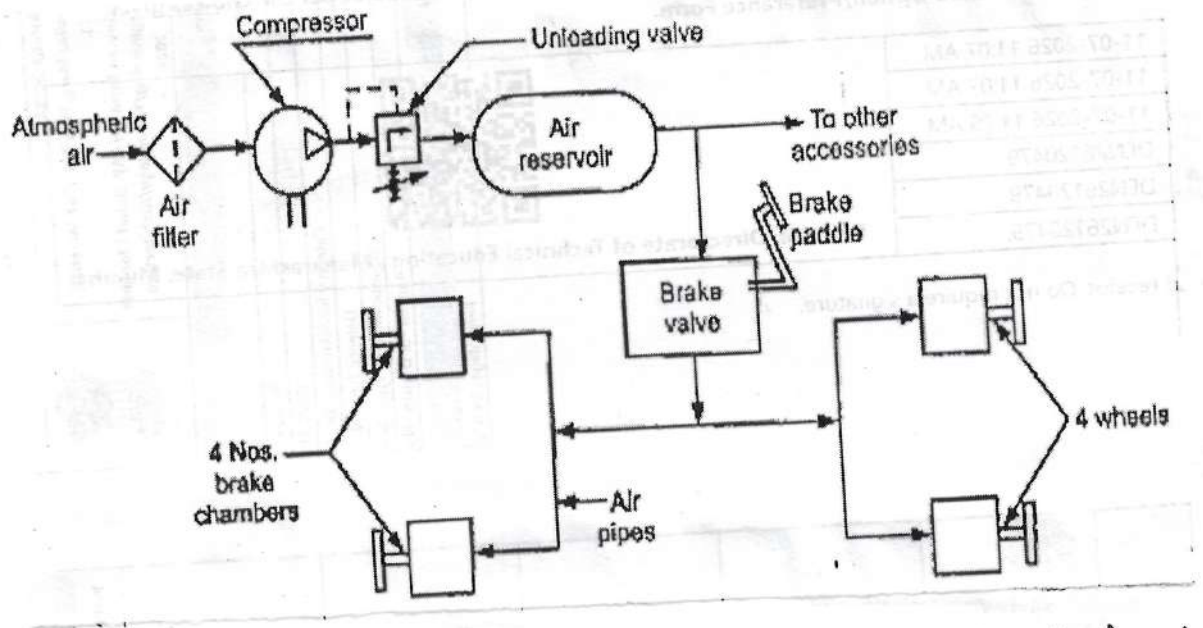
Advantages -

- Uniform braking on all wheels;
- Higher efficiency, smooth operation,

Disadvantages -

- Fluid leakage can cause failure
- Costlier.

* Air Brake System :-



It is a braking system in which compressed air is used to apply brakes. It is mainly used in vehicles (heavy) like trucks & buses.

Construction -

- Air compressor - compresses air
- Air Reservoir - Stores compressed air
- Foot valve (Brake pedal) - Controls air flow.
- Brake Chamber - Converts air pressure into force.
- Brake Drum / Disc - Produces braking action.

Working -

- The compressor compresses air & stores it in the reservoir.
- When the brake pedal is pressed, compressed air flows to the brake chamber.
- The air pressure moves a diaphragm / piston,

- This force applies brake shoes & or pads on drum/disc.
- When pedal is released, air is exhausted & brakes are released.

Advantages -

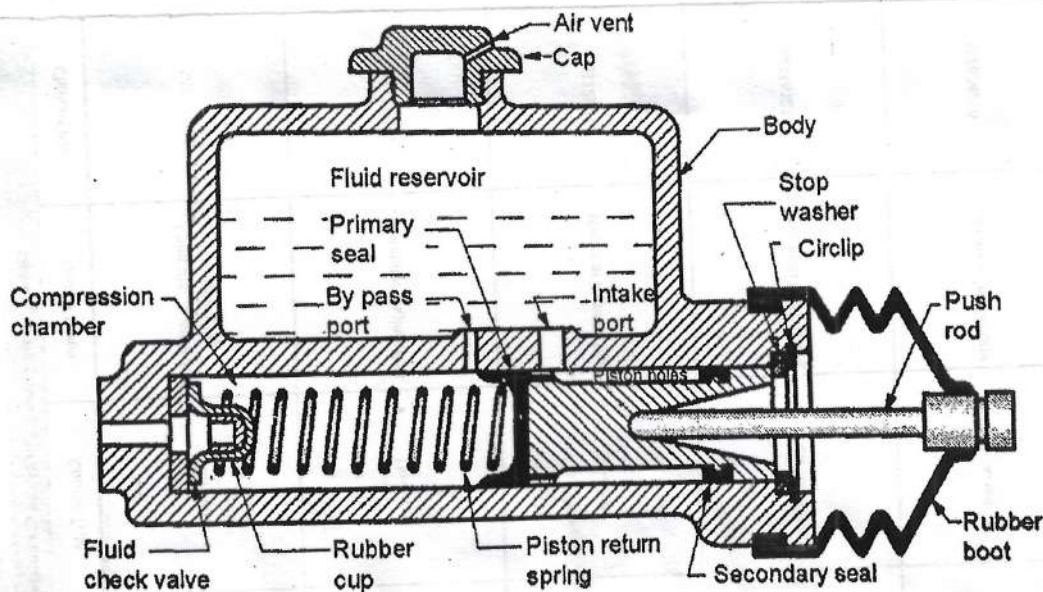
- High braking force
- Safe (no fluid leakage)
- Suitable for heavy vehicles.

Disadvantages -

- High initial cost
- Requires maintenance.
- Slight delay in response.

3.2 Major components of Hydraulic braking system: Master Cylinder, Wheel cylinder.

* Master Cylinder -



Function - Converts driver's foot force into hydraulic pressure.

Construction -

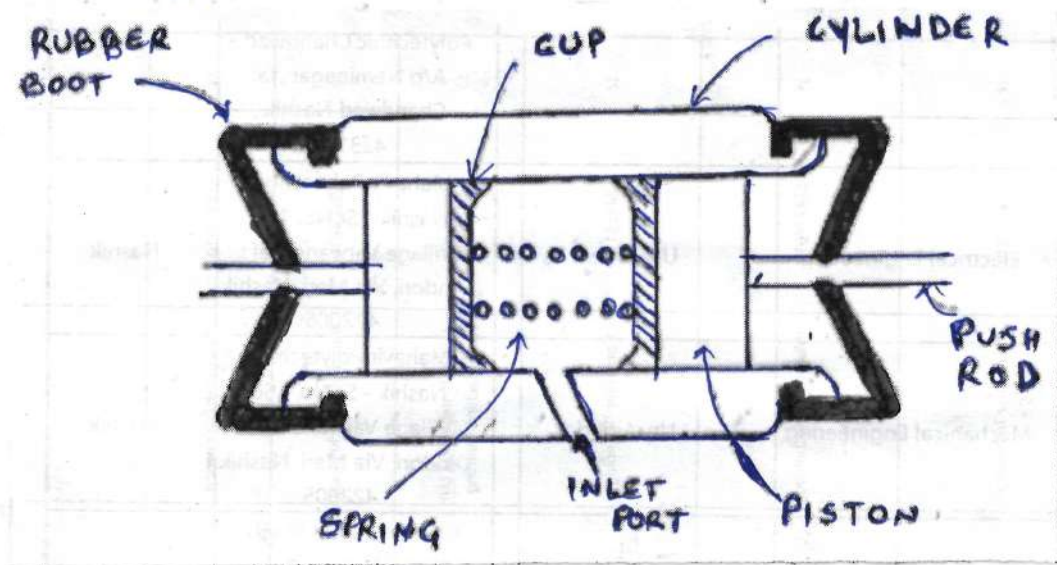
- Reservoir - Stores brake fluid
- Cylinder - Hollow body where piston moves.
- piston - Moves when pedal is pressed.
- spring - Returns piston to original position.

• ports (inlet & outlet) - Allow fluid movement.

Working -

1. When brake pedal is pressed $\rightarrow$ piston moves forward.
2. Brake fluid gets compressed inside cylinder.
3. Pressure is created in fluid.
4. This pressure is transmitted through pipes to wheel cylinder.

* Wheel cylinder.



Function - Converts hydraulic pressure into mechanical force to apply brakes.

Construction -

- Cylinder body
- Two pistons (left & right)
- Rubber seals (prevent leakage)
- Bleeder valve (removes air)

Working -

- Pressurized fluid enters wheel cylinder.
- Pistons move outward.
- Brake shoes press against brake drum.
- Friction is produced $\rightarrow$ wheel slows/stops.

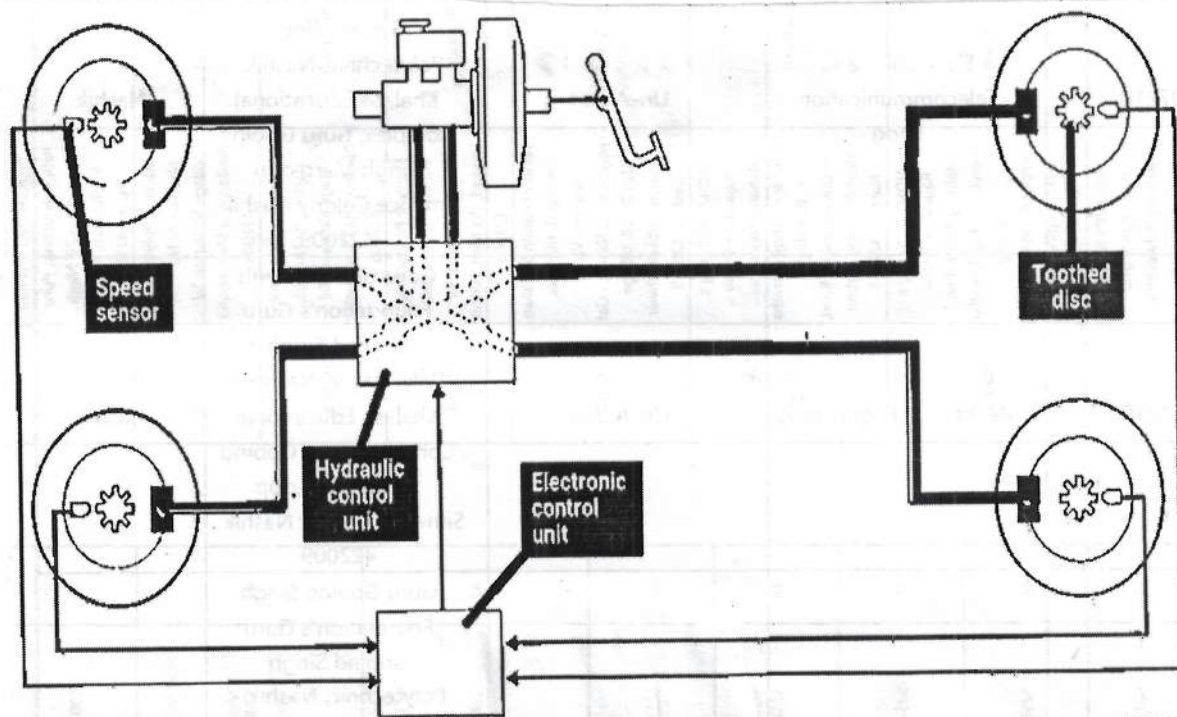
3.3 Antilock brake System (ABS) : Introduction.

Introduction -

- Antilock Braking System (ABS) is a safe system used in vehicles.
- It prevents wheel locking during sudden or hard braking.
- Helps the driver maintain control & steering while braking.

Why ABS is Needed -

- In normal braking, wheels may lock & skid.
- Skidding causes loss of control.
- ABS avoids this by controlling brake pressure.



Basic Components :

- Wheel speed sensor - detects wheel speed.
- Electronic Control Unit (ECU) - Processes signals.
- Hydraulic Control Unit (HCU) - Controls brake pressure.
- Valves & Pump - Adjust pressure automatically.

Working:-

1. Driver applies brake
2. Sensors detect wheel speed
3. If wheel tends to lock → ~~to~~ ECU sends signal
4. Valves reduce brake pressure.
5. Wheel keeps rotating without skidding.

Advantages -

- Prevents skidding, increases safety.
- Improves vehicle control
- Reduces stopping distance (on most surfaces)

3.4 Steering system: Function & Requirements, Construction of steering linkages for rigid axle & Independent suspension systems.

* Function of Steering System.

- To control direction of vehicle
- To provide smooth & stable turning.
- To ensure minimum tyre wear
- To give driver comfort & safety.

* Requirements of Good Steering System -

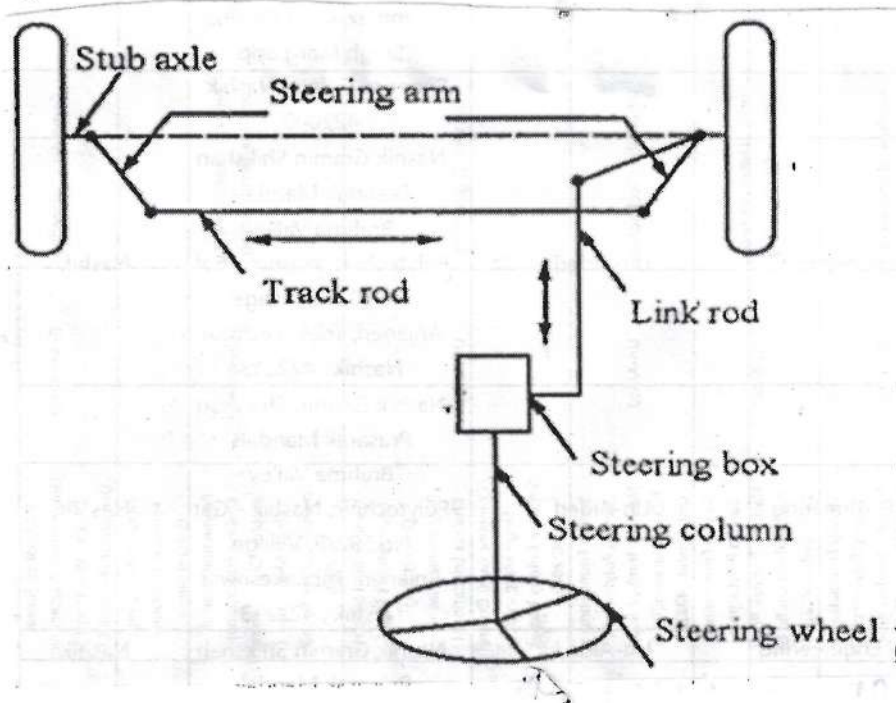
- Easy to operate (less effort)
- Accurate steering control
- Stability at high speed.
- Self-centering action (returns to straight position)
- Minimum wear & tear.

* Rigid Axle Steering Linkages -

Main Parts -

- Steering wheel - input from driver
- Steering Gear box - Converts motion,

- pitman arm - Transfers motion
- Drag link - Connects pitman arm to steering arm.
- Steering arm - Turns the wheel
- Tie Rod - Connects both front wheels.
- Kingpin - Pivot for wheel rotation,



Working -

- Driver turns steering wheel.
- Motion goes to gearbox → pitman arm → drag link.
- Drag link moves steering arm
- Tie rod turns both wheels together.
- Vehicle changes direction.

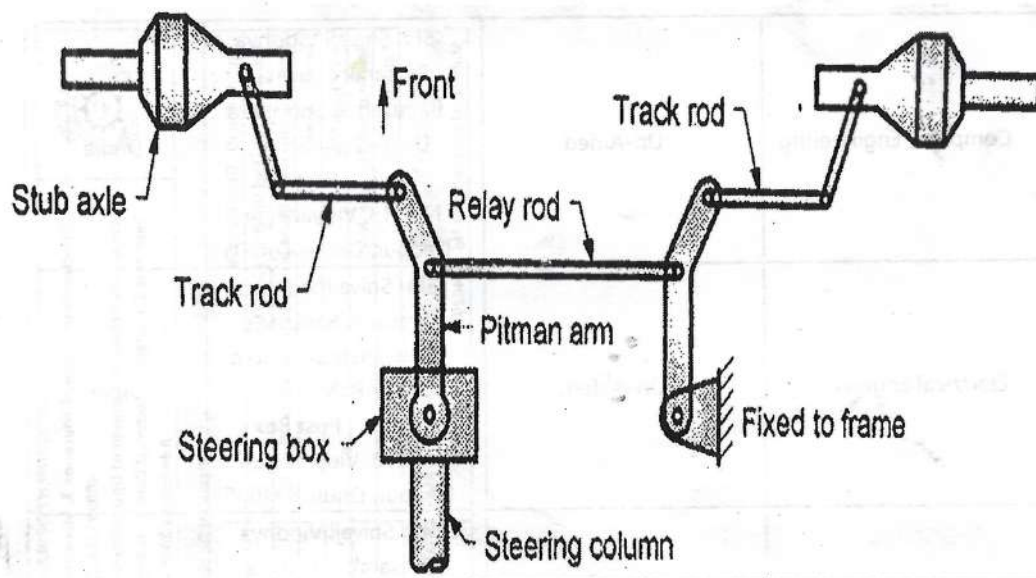
* Independent Suspension System -

Definition- It is a system in which each wheel moves independently of the other wheel on the same axle.

Construction -

- Control Arms (Wishbones) - Connect wheel to Chassis
- Coil spring - Absorbs shocks
- Shock Absorber (Damper) - Controls vibrations.
- Steering knuckle - Holds wheel hub
- Ball joints - Allow movement

• frame/ chassis - Supports system.



Working -

1. When a wheel hits a bump.
2. Only that wheel moves up/down.
3. Spring compresses to absorb shock.
4. Shock absorber controls oscillations.
5. Other wheel remains unaffected.
6. Provides smooth ride & stability.

Advantages -

- Better ride comfort, Better vehicle stability.
- Improved road grip.
- Less vibration transfer.

Disadvantages -

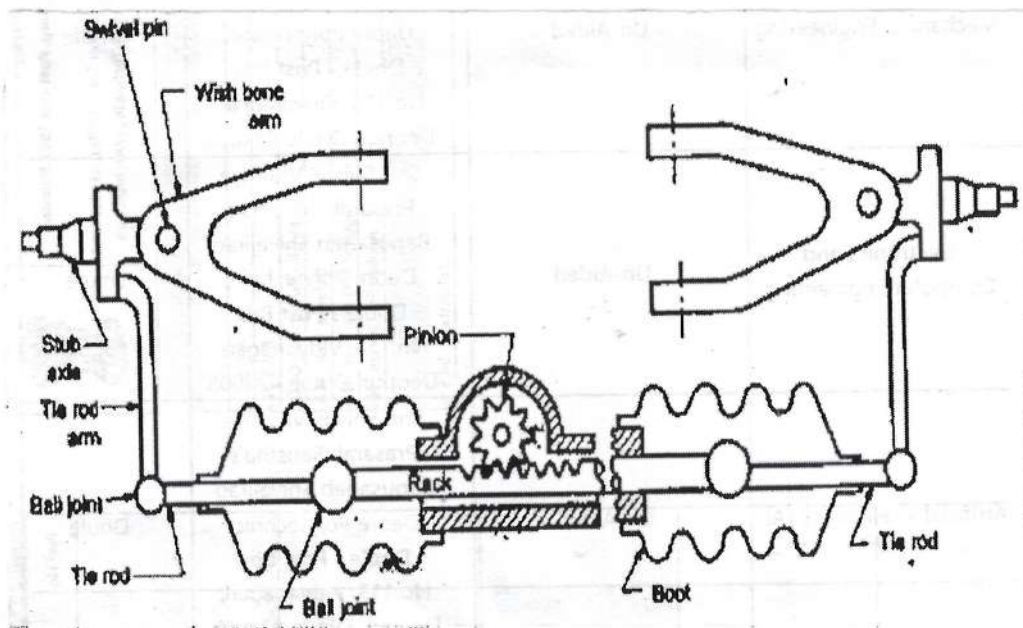
- Complex construction
- Higher cost
- Maintenance required.

3.5 Steering Gear Box: Types, construction & working of Rack & Pinion, Recirculating ball type steering gear box, Necessity & principle of power steering.

* Types of Steering Gear Boxes -

1. Rack & pinion steering gear
2. Worm & Worm Wheel steering gear
3. Worm & Nut steering gear.
4. Worm & Roller steering gear
5. Recirculating Ball type steering gear
6. Hydraulics & Electronics power steering gear

* Rack & Pinion Steering Gear Box :-



Construction -

- Steering wheel - Driver input
- Steering shaft - Connects wheel to pinion
- Pinion Gear - small circular gear
- Rack - straight toothed bar
- Tie Rods - Connect rack to wheels
- Housing - Encloses mechanism

Working -

- Driver rotates steering wheel
- Steering shaft rotates pinion gear
- Pinion moves the rack (left/right)
- Rack pushes/pulls tie rods.
- Tie rods turn the front-wheels
- Vehicle changes direction

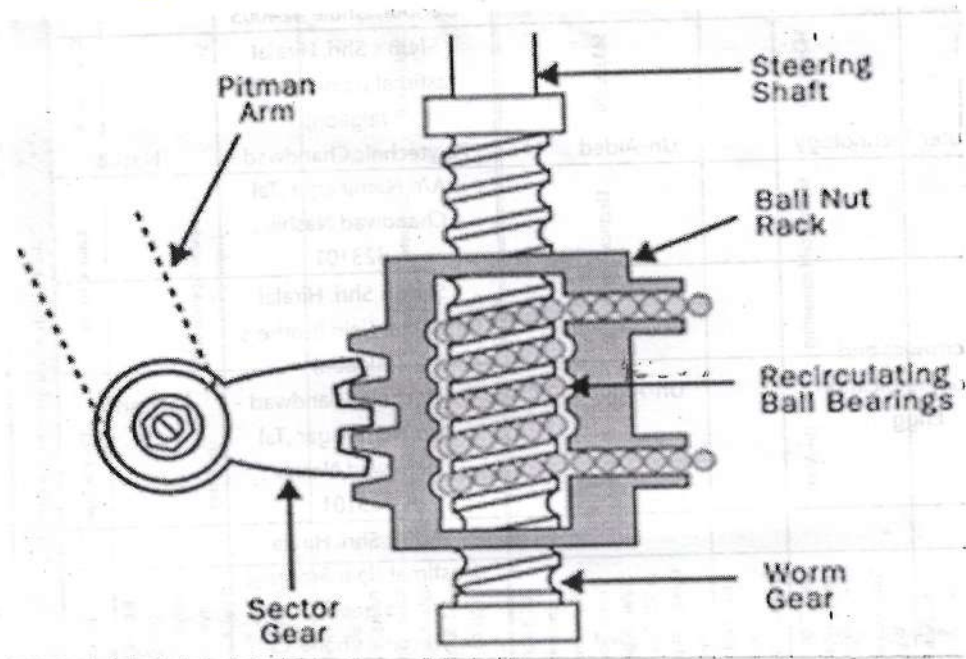
Advantages -

- simple construction, Less weight
- Accurate steering control, Quick response.

Disadvantages -

- Not suitable for heavy vehicles.
- More wear in rough conditions.

* Recirculating Ball Type Steering Gear Box -



Construction -

- Steering wheel & shaft.
- Worm Gear (threaded shaft)
- Ball Nut (moves along worm)
- Steel Balls (circulate in grooves)
- Return Tube (recirculate balls)
- Sector Gear (Pitman Arm shaft)
- Gear Housing.

The balls are placed betⁿ worm & nut to reduce friction.

Working -

- Driver rotates the steering wheel.
- Worm gear rotates
- Steel balls roll betⁿ worm & nut
- Ball nut moves forward / backward
- Sector gear rotates due to nut movement.
- Pitman arm moves → turns wheels.

Balls keep circulating continuously $\rightarrow$ smooth motion.

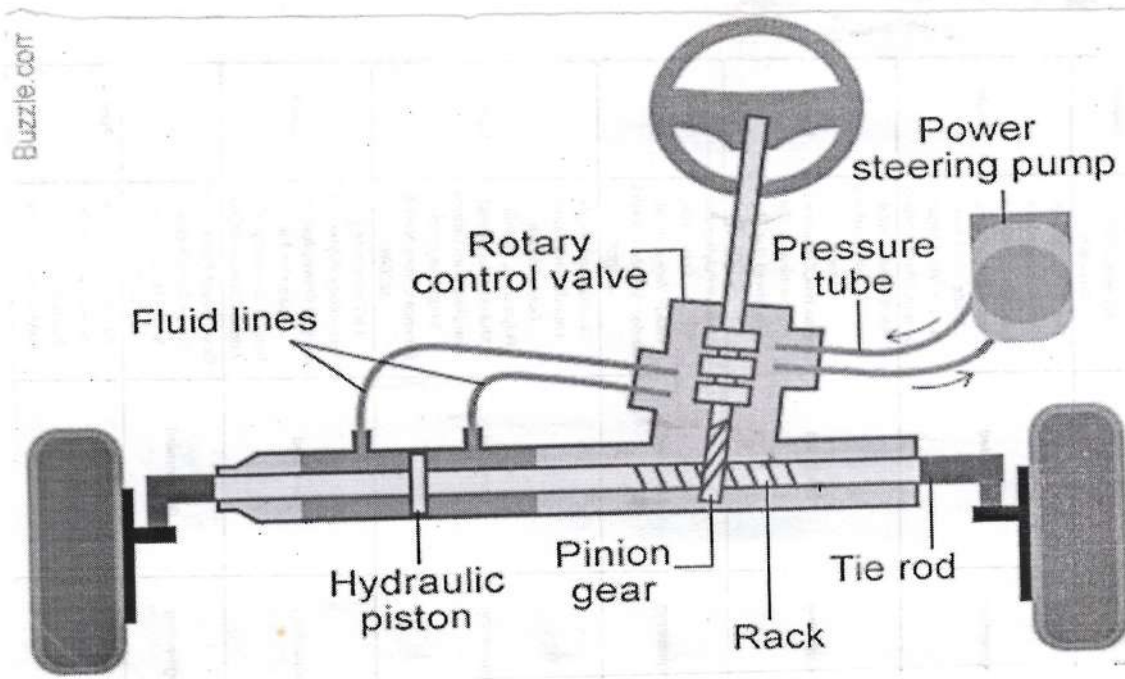
Advantages -

- Less friction & wear, smooth steering
- Suitable for heavy vehicles.

Disadvantages -

- Complex construction, more costly.
- Requires maintenance.

* Power Steering -



• Necessity -

- Reduces driver effort.
- Required for heavy vehicles.
- Provides easy turning at low speed.
- Improves comfort & control.

• Principle of Power steering -

- It works on hydraulic pressure principle.
- Engine-driven pump supplies pressurized fluid.
- fluid assists movement of steering mechanism.
- Reduces manual effort req^d by driver.

• Working -

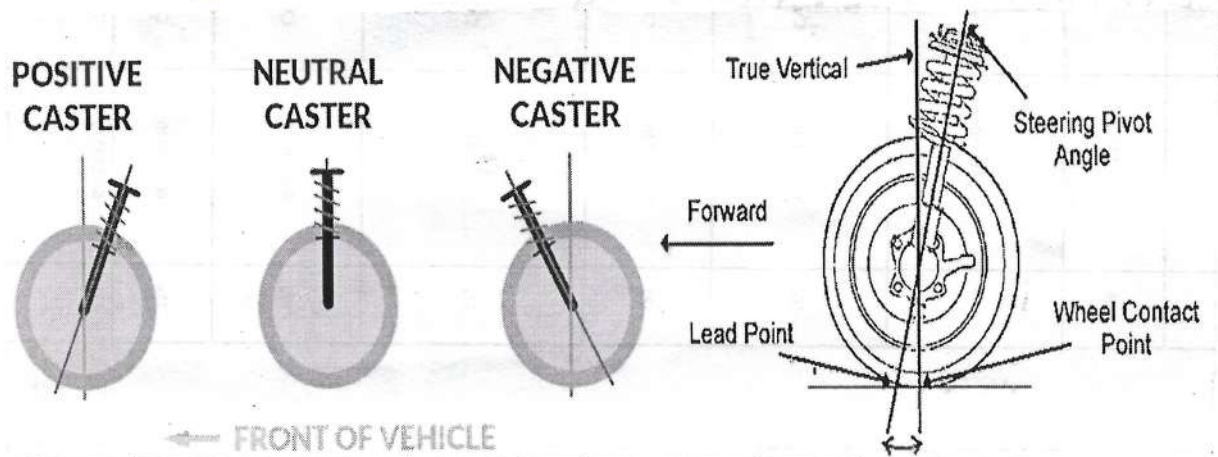
1. Pump pressurizes hydraulic fluid
2. Control Valve directs fluid.
3. Fluid pushes piston in steering gear.
4. Helps move rack/sector gear.
5. Wheels turn with less effort.

3.6 Steering Geometry : Castor, Camber, Toe-in, Toe-out king pin inclination, understeer & oversteer.

* Steering Geometry -

It refers to the angular relationship betⁿ wheels & steering components which ensures proper vehicle control, stability & tyre life.

1. Castor Angle -

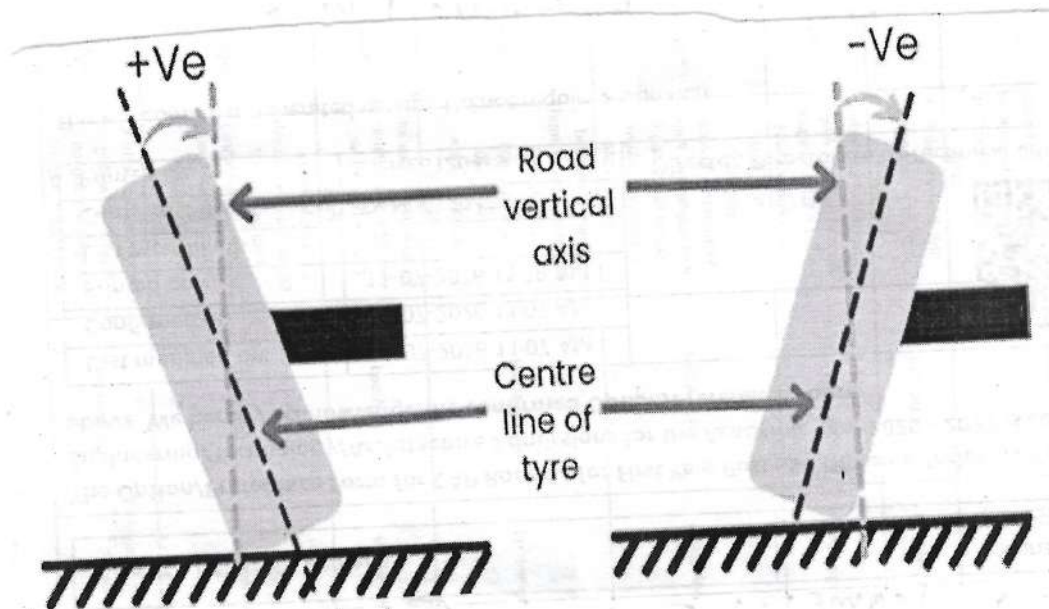


- It is the angle betⁿ steering axis & vertical line (side view).
- Positive castor → top tilts backward.
- Negative castor → top tilts forward.

Effects -

- Provides straight-line stability.
- Helps steering return to original position.

2. Camber Angle -



• It is the angle betⁿ wheel & vertical line (front view).

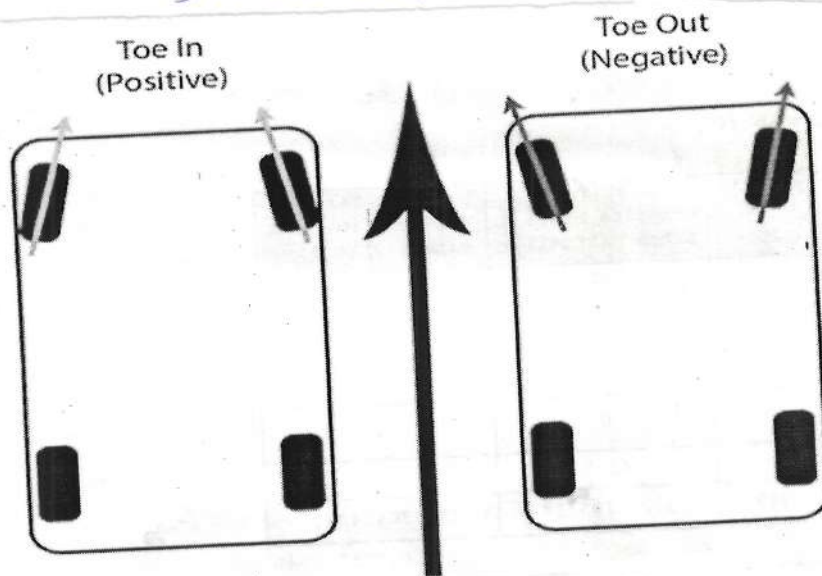
Types:

- positive camber → top outward
- Negative camber → top inward.

Effect:

- Reduces Tyre wear
- Improves road grip.

3. Toe in & Toe out -



• It is the angle betⁿ front wheels in horizontal plane.

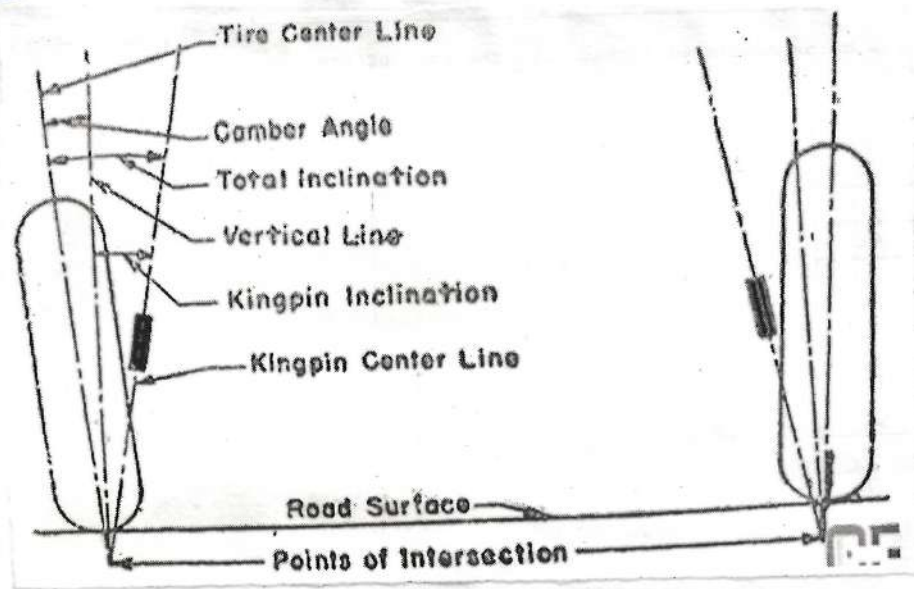
Types:

- Toe in → front wheel closer
- Toe out → front wheel apart.

Effects:

- Ensures parallel running of wheels.
- Reduces tyre wear.

4. King Pin Inclination (KPI) -

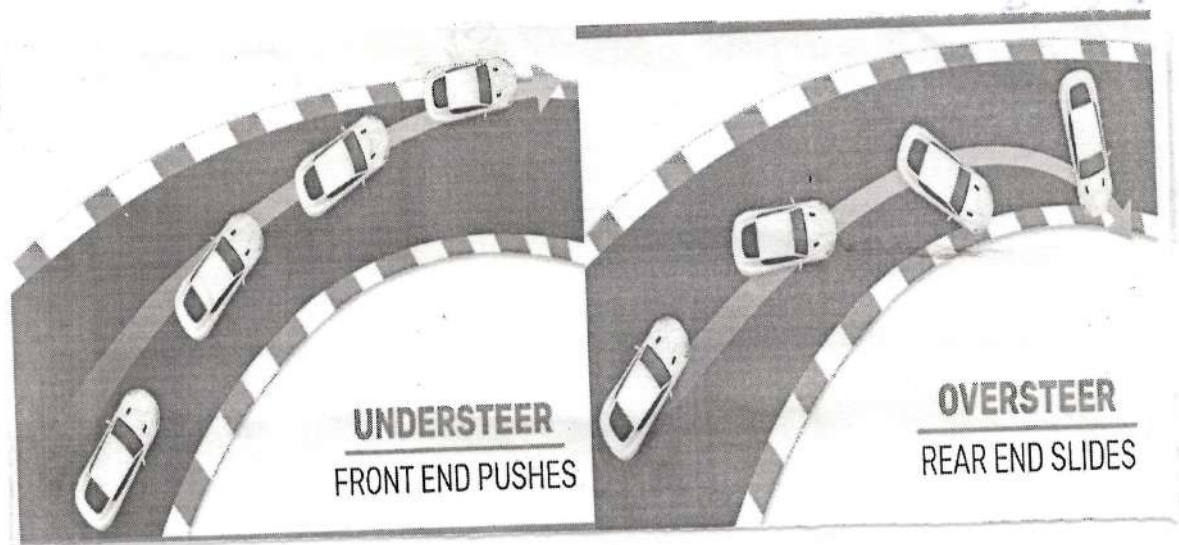


- It is the angle betⁿ kingpin (steering axis) & vertical line (front view).

Effects:

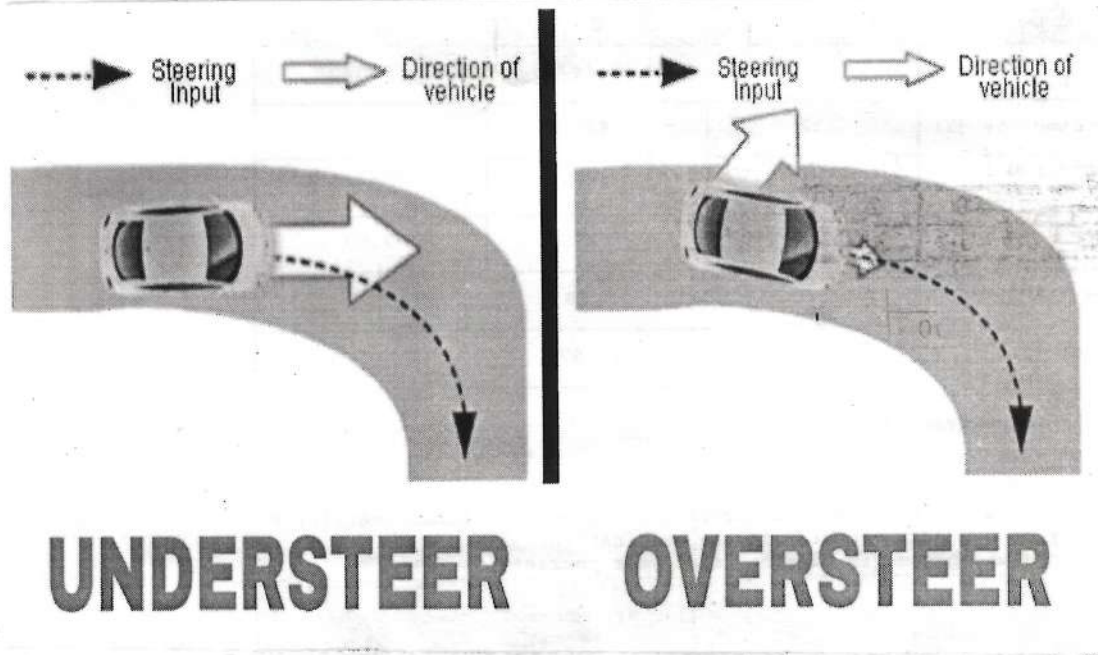
- Reduces steering effort
- Improves directional stability.

5. Understeer -



- vehicle turns less than expected.
- front wheel lose grip.
- e.g. Car goes straight even when steering is turned.

6. Oversteer -



- Vehicle turns more than expected.
- Rear wheel lose grip.
- e.g. Car spins during turning.

Harry
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