SUB –AUTOMOBILE ENGG.

ENGINE SUPPORT SYSTEMS:

- Cooling system
- Lubrication system
- Fuel and ignition/injection system
- Intake system Exhaust system

Cooling system:

The cooling system removes excess heat to keep the inside of the engine at an efficient temperature.

- Air Cooling
- Liquid Cooling

Water Jackets Surrounds the cylinders with water passage. Absorbs heat from the cylinder wall. Pump move water to radiator where heat is exchanged to the air.

Coolant Flow:

Coolant flows through the water jackets where it absorbs heat. It then flows through the radiator where heat is transferred to the air passing through. The amount of flow is determined by the water pump. The flow direction is controlled by the thermostat.

Warm Engine:

The thermostat opens when the engine warms up. This allows coolant to circulate through the radiator and the water jackets.

Cold Engine:

When an engine is cold, the thermostat is cold. Coolant flow is through the bypass hose and the water jackets. This allows the engine to warm up evenly.

Coolant :

- Coolant Water (Boiling Point 100° C)
- Glycerin (Boiling Point 290 ° C)
- Ethylene glycol (Boiling Point 197 ° C)
- Antifreeze (methyl alcohol, ethyl alcohol)

Cooling System:

- Water pump is driven by the crankshaft through Timing Belt (Keeps Cam and Crankshafts in time)
- Drive/accessory Belt (Runs alternator, power-steering pump, AC, etc.) Serpentine Belt V- Belt
- Electric fan is mounted on the radiator and is operated by battery

power. It is controlled by the thermostat switch.

Need for cooling system

The cooling system has four 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.
4. Provide a means for heater operation (warming the passenger compartment).

Types of cooling system:

The different Types of cooling system are

1. Air cooling system
2. Liquid cooling system
3. Forced circulation system
4. Pressure cooling system

Air-Cooled System :

The simplest type of cooling is the air-cooled, or direct, method in which the heat is drawn off by moving air in direct contact with the engine Several fundamental principles of cooling are embodied in this type of engine cooling. The rate of the cooling is dependent upon the following:

1. The area exposed to the cooling medium.
2. The heat conductivity of the metal used & the volume of the metal or its size in cross section .
3. The amount of air flowing over the heated surfaces.
4. The difference in temperature between the exposed metal surfaces and the cooling air.

Liquid-cooled system;

Nearly all multi cylinder engines used in automotive, construction, and material- handling equipment use a liquid-cooled system. Any liquid used in this type of system is called a COOLANT.

A simple liquid-cooled system consists of a radiator, coolant pump, piping, fan, thermostat, and a system of water jackets and passages in the cylinder head and block through which the coolant circulates. Some vehicles are equipped with a coolant distribution tube inside the cooling passages that directs additional coolant to the points where temperatures are highest.

Cooling of the engine parts is accomplished by keeping the coolant

circulating and in contact with the metal surfaces to be cooled. The operation of a liquid- cooled system is as follows:

The pump draws the coolant from the bottom of the radiator, forcing the coolant through the water jackets and passages, and ejects it into the upper radiator tank. The coolant then passes through a set of tubes to the bottom of the radiator from which the cooling cycle begins.

The radiator is situated in front of a fan that is driven either by the water pump or an electric motor. The fan ensures airflow through the radiator at times when there is no vehicle motion. The downward flow of coolant through the radiator creates what is known as a thermosiphon action. This simply means that as the coolant is heated in the jackets of the engine, it expands. As it expands, it becomes less dense and therefore lighter. This causes it to flow out of the top outlet of the engine and into the top tank of the radiator. As the coolant is cooled in the radiator, it again becomes more dense and heavier. This causes the coolant to settle to the bottom tank of the radiator.

The heating in the engine and the cooling in the radiator therefore create a natural circulation that aids the water pump. The amount of engine heat that must be removed by the cooling system is much greater than is generally realized. To handle this heat load, it may be necessary for the cooling system in some engine to circulate 4,000 to 10,000 gallons of coolant per hour. The water passages, the size of the pump and radiator, and other details are so designed as to maintain the working parts of the engine at the most efficient temperature within the limitation imposed by the coolant.

5. Pressure cooling system.

The radiator pressure cap is used on nearly all of the modern engines. The radiator cap locks onto the radiator tank filler neck Rubber or metal seals make the cap-to-neck joint airtight. The functions of the pressure cap are as follows:

1. Seals the top of the radiator tiller neck to prevent leakage.
2. Pressurizes system to raise boiling point of coolant.
3. Relieves excess pressure to protect against system damage.
4. In a closed system, it allows coolant flow into and from the coolant reservoir.

The radiator cap pressure valve consists of a spring- loaded disc that contacts the filler neck. The spring pushes the valve into the neck to form a seal. Under pressure, the boiling point of water increases. Normally water boils at 212°F.

However, for every pound of pressure increase, the boiling point goes up 3°F. Typical radiator cap pressure is 12 to 16 psi. This raises the boiling point of the engine coolant to about 250°F to 260°F. Many surfaces inside the water jackets can be above 212°F. If the engine overheats and the pressure exceeds the cap rating, the pressure valve opens. Excess pressure forces coolant out of the overflow tube and into the reservoir or onto the ground.

This prevents high pressure from rupturing the radiator, gaskets, seals, or hoses. The radiator cap vacuum valve opens to allow reverse flow back into the radiator when the coolant temperature drops after engine operation. It is a smaller valve located in the center, bottom of the cap.

The cooling and contraction of the coolant and air in the system could decrease coolant volume and pressure. Outside atmospheric pressure could then crush inward on the hoses and radiator. Without a cap vacuum or vent valve, the radiator hose and radiator could collapse

Lubrication System:

Parts require lubrications Crankshaft bearing Piston pin Timing gears Valve mechanism Piston ring and cylinder walls Camshaft and bearings.

Purpose of lubrication:

- Reduce friction & wear - by creating a thin film (Clearance) between moving parts
- Seal power - The oil helps form a gastight seal between piston rings and cylinder walls
- Cleaning - Cleans As it circulates through the engine, the oil picks up metal particles and carbon, and brings them back down to the pan.
- Absorb shock - When heavy loads are imposed on the bearings, the oil helps to cushion the load
- Cooling. - Cools Picks up heat when moving through the engine and then drops into the cooler oil pan, giving up some of this heat.

Types Lubrication System:

- Petroil system
- Splash system
- Pressure system
- Dry-sump system

Oil change:

- Every 5000Km for four wheeler , Every 2000 Km in two wheeler Ignoring regular oil change intervals will shorten engine life and performance.

All internal combustion engines are equipped with an internal lubricating system. Without lubrication, an engine quickly overheats and its working parts seize due to excessive friction. All moving parts must be

adequately lubricated to assure maximum wear and long engine life.

Purpose of Lubrication;

The functions of an engine lubrication system are as follows: Reduces friction and wear between moving parts. Helps transfer heat and cool engine parts. Cleans the inside of the engine by removing contaminants (metal, dirt, plastic, rubber, and other particles).

Absorbs shocks between moving parts to quiet engine operation and increase engine life. The properties of engine oil and the design of modern engines allow the lubrication system to accomplish these functions.

Types of Lubrication Systems;

Now that you are familiar with the lubricating system components, you are ready to study the different systems that circulate oil through the engine. The systems used to circulate oil are known as splash, combination splash force feed, force feed, and full force-feed.

Splash Systems

The splash system is no longer used in automotive engines. It is widely used in small four- cycle engines for lawn mowers, outboard marine operation, and so on. In the splash lubricating system, oil is splashed up from the oil pan or oil trays in the lower part of the crankcase.

The oil is thrown upward as droplets or fine mist and provides adequate lubrication to valve mechanisms, piston pins, cylinder walls, and piston rings. In the engine, dippers on the connecting-rod bearing caps enter the oil pan with each crankshaft revolution to produce the oil splash.

A passage is drilled in each connecting rod from the dipper to the bearing to ensure lubrication. This system is too uncertain for automotive applications. One reason is that the level of oil in the crankcase will vary greatly the amount of lubrication received by the engine. A high level results in excess lubrication and oil consumption and a slightly low level results in inadequate lubrication and failure of the engine.

Combination Splash and Force Feed

In a combination splash and force feed, oil is delivered to some parts by means of splashing and other parts through oil passages under pressure from the oil pump. The oil from the pump enters the oil galleries. From the oil galleries, it flows to the main bearings and camshaft bearings.

The main bearings have oil-feed holes or grooves that feed oil into drilled passages in the crankshaft. The oil flows through these passages to the connecting rod bearings. From there, on some engines, it flows through holes drilled in the connecting rods to the piston-pin bearings. Cylinder walls are lubricated by splashing oil thrown off from the connecting-rod bearings.

Some engines use small troughs under each connecting rod that are kept full by small nozzles which deliver oil under pressure from the oil pump. These oil nozzles deliver an increasingly heavy stream as speed increases. At very high speeds these oil streams are powerful enough to strike the dippers directly. This causes a much heavier splash so that adequate lubrication of the pistons and the connecting-rod bearings is provided at higher speeds. If a combination system is used on an overhead valve engine, the upper valve train is lubricated by pressure from the pump.

Force Feed

A somewhat more complete pressurization of lubrication is achieved in the force-feed lubrication system. Oil is forced by the oil pump from the crankcase to the main bearings and the camshaft bearings. Unlike the combination system the connecting-rod bearings are also fed oil under pressure from the pump. Oil passages are drilled in the crankshaft to lead oil to the connecting-rodbearings.

IGNITION SYSTEM

The fuel feed system for the Spark ignition engines and Compression ignition engines are clearly discussed below.

Fuel Injection system for SI engines;

Carburetion

Spark-ignition engines normally use volatile liquid fuels. Preparation of fuel-air mixture is done outside the engine cylinder and formation of a homogeneous mixture is normally not completed in the inlet manifold. Fuel droplets, which remain in suspension, continue to evaporate and mix with air even during suction and compression processes. The process of mixture preparation is extremely important for spark-ignition engines. The purpose of carburetion is to provide a combustible mixture of fuel and air in the required quantity and quality for efficient operation of the engine under all conditions.

Definition of Carburetion;

The process of formation of a combustible fuel-air mixture by mixing the proper amount of fuel with air before admission to engine cylinder is called carburetion and the device which does this job is called a carburetor.

Definition of Carburetor;

The carburetor is a device used for atomizing and vaporizing the fuel and mixing it with the air in varying proportions to suit the changing

operating conditions of vehicle engines.

Factors Affecting Carburetion

Of the various factors, the process of carburetion is influenced by
i. The engine speed
ii. The vaporization characteristics of the fuel
iii. The temperature of the incoming air and
iv. The design of the carburetor

Introduction of Ignition System;

- For petrol engine - Battery ignition system , Magneto ignition system Injection system
- For diesel engine - Fuel supply system.

Battery ignition system:

Battery ignition system has the following elements

- Primary Ignition Circuit(low voltage)
- Battery
- Ignition switch
- Primary windings of coil
- Contact breaker
- capacitor
- Secondary Ignition Circuit (high voltage)
- Secondary windings of coil
- Distributor cap and rotor (if the vehicle is so equipped)
- Spark plug wires &
- Spark plugs

IGNITION SYSTEM – Magneto System Ignition Switch Distribution Contact Breaker Coil Magneto Condenser Power Generation Spark Generation Magneto Unit Rotor Arm

IGNITION SYSTEM – Dynamo/Alternator System Dynamo/ Alternator Distributor Contact Breaker Coil Ignition Switch Secondary Windings Primary Windings Condenser Battery

Ignition Switch Coil Packs IGNITION SYSTEM – Electronic Systems Control Unit Timing Sensor Timing Disc Engine Speed Sensing Unit Alternator Battery

In all spark ignition engines which work on the Gasoline either 2-Stroke or 4-Stroke cycle principle and utilize a carburetor or fuel injection system, the combustion of the air-fuel mixture is initiated by an electric

spark.

The term ‘Spark Ignition’ means that a brief electric arc is produced between the electrodes of a spark plug, the energy for which is derived from an external power source. In most cases this power source is the vehicle battery, which is constantly being supplemented by the alternate while the vehicle is mobile.

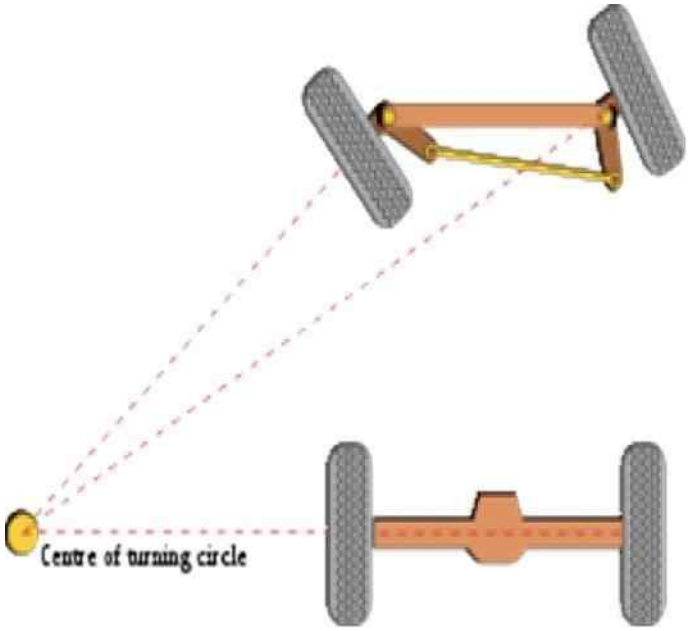
A different method of ignition is employed in diesel engines. This is called ‘compression ignition’ and relies on the fact that when air compressed, its temperature rises. In diesel engines, compression ratio of between 16:1 and 25:1 are common, and at the end of a compression the temperature of the trapped air is sufficiently high to ignite the diesel fuel that is sprayed into the cylinder at the appropriate time.

STEERING SYSTEM AND SUSPENSION SYSTEMS

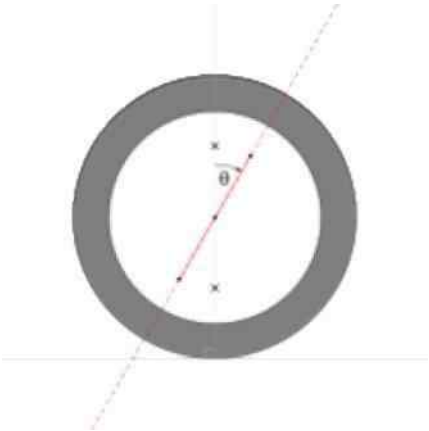
Introduction of Steering system

Steering is the collection of components, linkages, etc. which allow a vessel (ship,boat) or vehicle (car, motorcycle, bicycle) to follow the desired course. An exception is the case of rail transport by which rail tracks combined together with railroad switches (and also known as 'points' in British English) provide the steering function.

The most conventional steering arrangement is to turn the front wheels using a hand– operated steering wheel which is positioned in front of the driver, via the steering column, which may contain universal joints (which may also be part of the collapsible steering column design), to allow it to deviate somewhat from a straight line. Other arrangements are sometimes found on different types of vehicles, for example, a tiller or rear–wheel steering. Tracked vehicles such as bulldozers andtanks usually employ differential steering — that is, the tracks are made to move at different speeds or even in opposite directions, using clutches and brakes, to bring about a change of course or direction.



Ackermann steering geometry



Caster angle θ indicates kingpinpivot line and gray area indicates vehicle's tire with the wheel moving from right to left. A positive caster angle aids in directional stability, as the wheel tends to trail, but a large angle makes steering more difficult.

Curves described by the rear wheels of a conventional automobile. While the vehicle moves with a constant speed its inner and outer rear wheels do not.

The basic aim of steering is to ensure that the wheels are pointing in the desired directions. This is typically achieved by a series of linkages, rods, pivots and gears. One of the fundamental concepts is that of caster angle – each wheel is steered with a pivot point ahead of the wheel; this makes the steering tend to be self-centering towards the direction of travel.

The steering linkages connecting the steering box and the wheels usually conforms to a variation of Ackermann steering geometry, to account for the fact that in a turn, the inner wheel is actually travelling a path of smaller radius than the outer wheel, so that the degree of toe suitable for driving in a straight path is not suitable for turns. The angle the wheels make

with the vertical plane also influences steering dynamics (see camber angle) as do the tires.

Rack and pinion, recirculating ball, worm and sector

Rack and pinion steering mechanism:

1. Steering wheel;
2. Steering column;
3. Rack and pinion;
4. Tie rod;
5. Kingpin

Rack and pinion unit mounted in the cockpit of an Ariel Atom sports car chassis. For most high volume production, this is usually mounted on the other side of this panel

Steering box of a motor vehicle, the traditional (non-assisted), you may notice that the system allows you to adjust the braking and steering systems, you can also see the attachment system to the frame.

Many modern cars use rack and pinion steering mechanisms, where the steering wheel turns the pinion gear; the pinion moves the rack, which is a linear gear that meshes with the pinion, converting circular motion into linear motion along the transverse axis of the car (side to side motion). This motion applies steering torque to the swivel pin ball joints that replaced previously used kingpins of the stub axle of the steered wheels via tie rods and a short lever arm called the steering arm.

The rack and pinion design has the advantages of a large degree of

feedback and direct steering "feel". A disadvantage is that it is not adjustable, so that when it does wear and develop lash, the only cure is replacement.

Older designs often use the recalculating ball mechanism, which is still found on trucks and utility vehicles. This is a variation on the older sector design; the steering column turns a large screw (the "worm gear") which meshes with a sector of a gear, causing it to rotate about its axis as the worm gear is turned; an arm attached to the axis of the sector moves the Pitman arm, which is connected to the steering linkage and thus steers the wheels. The recalculating ball version of this apparatus reduces the considerable friction by placing large ball bearings between the teeth of the worm and those of the screw; at either end of the apparatus the balls exit from between the two pieces into a channel internal to the box which connects them with the other end of the apparatus, thus they are "recalculated".

The recirculating ball mechanism has the advantage of a much greater mechanical advantage, so that it was found on larger, heavier vehicles while the rack and pinion was originally limited to smaller and lighter ones; due to the almost universal adoption of power steering, however, this is no longer an important advantage, leading to the increasing use of rack and pinion on newer cars.

The recirculating ball design also has a perceptible lash, or "dead spot" on center, where a minute turn of the steering wheel in either direction does not move the steering apparatus; this is easily adjustable via a screw on the end of the steering box to account for wear, but it cannot be entirely eliminated because it will create excessive internal forces at other positions and the mechanism will wear very rapidly. This design is still in use in trucks and other large vehicles, where rapidity of steering and direct feel are less important than robustness, maintainability, and mechanical advantage.

The worm and sector was an older design, used for example in Willys and Chrysler vehicles, and the Ford Falcon (1960s).

Other systems for steering exist, but are uncommon on road vehicles. Children's toys and go- karts often use a very direct linkage in the form of abellcrank (also commonly known as a Pitman arm) attached directly between the steering column and the steering arms, and the use of cable-operated steering linkages (e.g. the Capstan and Bowstring mechanism) is also found on some home-built vehicles such as soapbox cars and recumbent tricycles.

Steering Gear Boxes;

The steering gears converts the rotary motion of the steering wheel into the to-and-fro motion of the link rod of the steering linkages. Moreover

it also provides necessary leverage so that the driver is able to steer the vehicle without fatigue.

There are various types of steering gear boxes are available in automobile.

- Worm and Wheel steering gear box,
- Cam and double roller steering gear box,
- Worm and nut steering gear box,
- Recalculating ball type steering gear box,

Rack and pinion steering gear box

Power steering

In automobiles, power steering (also known as power assisted steering (PAS) or steering assist system) helps drivers steer by augmenting steering effort of the steering wheel.

Hydraulic or electric actuators add controlled energy to the steering mechanism, so the driver needs to provide only modest effort regardless of conditions. Power steering helps considerably when a vehicle is stopped or moving slowly. Also, power steering provides some feedback of forces acting on the front wheels to give an ongoing sense of how the wheels are interacting with the road; this is typically called "road feel".

Representative power steering systems for cars augment steering effort via an actuator, a hydraulic cylinder, which is part of a servo system. These systems have a direct mechanical connection between the steering wheel and the linkage that steers the wheels.

This means that power-steering system failure (to augment effort) still permits the vehicle to be steered using manual effort alone.

Other power steering systems (such as those in the largest off-road construction vehicles) have no direct mechanical connection to the steering linkage; they require power. Systems of this kind, with no mechanical connection, are sometimes called "drive by wire" or "steer by wire", by analogy with aviation's "fly-by-wire". In this context, "wire" refers to electrical cables that carry power and data, not thin-wire-rope mechanical control cables.

In other power steering systems, electric motors provide the assistance instead of hydraulic systems. As with hydraulic types, power to the actuator (motor, in this case) is controlled by the rest of the power-steering system.

Some construction vehicles have a two-part frame with a rugged hinge in the middle; this hinge allows the front and rear axles to become non-parallel to steer the vehicle. Opposing hydraulic cylinders move the halves of the frame relative to each other to steer.

Power steering helps the driver of a vehicle to steer by directing some

of the power to assist in swiveling the steered road wheels about their steering axes. As vehicles have become heavier and switched to front wheel drive, particularly using negative offset geometry, along with increases in tire width and diameter, the effort needed to turn the wheels about their steering axis has increased, often to the point where major physical exertion would be needed were it not for power assistance.

To alleviate this auto makers have developed power steering systems: or more correctly power-assisted steering—on road going vehicles there has to be a mechanical linkage as a failsafe. There are two types of power steering systems; hydraulic and electric/electronic. A hydraulic- electric hybrid system is also possible.A hydraulic power steering (HPS) uses hydraulic pressure supplied by an engine-driven pump to assist the motion of turning the steering wheel. Electric power steering (EPS) is more efficient than the hydraulic power steering, since the electric power steering motor only needs to provide assistance when the steering wheel is turned, whereas the hydraulic pump must run constantly.

Suspension system;

Suspension system is the term given to the system of springs, shock absorbers and linkages that connects a vehicle to its wheels . It is basically cushion for passengers protects the luggage or any cargo and also itself from damage and wear.

Sir **William Brush** is the father of suspension system in automobiles.

The main role of suspension system are as follows:

- It supports the weight of vehicle .
- Provides smoother ride for the driver and passengers i.e. acts as cushion.
- Protects your vehicle from damage and wear .
- It also plays a critical role in maintaining self driving conditions.
- It also keeps the wheels pressed firmly to the ground for traction .
- It isolates the body from road shocks and vibrations which would otherwise be transferred to the passengers and load.

Principle :

When a tire hits an obstruction, there is a reaction force. The size of this reaction force depends on the unsprung mass at each wheel assembly.

In general, the larger the ratio of sprung weight to unsprung weight, the less the body and vehicle occupants are affected by bumps, dips, and

other surface imperfections such as small bridges. A large sprung weight to unsprung weight ratio can also impact vehicle control.

No road is perfectly flat i.e. without irregularities. Even a freshly paved highways have subtle imperfections that can be interact with vehicle's wheels. These are the imperfections that apply forces on wheels.

According to **Newton 's law of motion** all forces have both magnitude and direction. A bump in the road causes the wheel to move up and down perpendicular to the road surface. The magnitude of course ,depends on whether the wheel is striking a giant bump or a tiny speck. Thus, either the wheel experiences a vertical acceleration as it passes over an imperfection.

The suspension of a car is actually part of the chassis, which comprises all of the important systems located beneath the car's body. These system include :

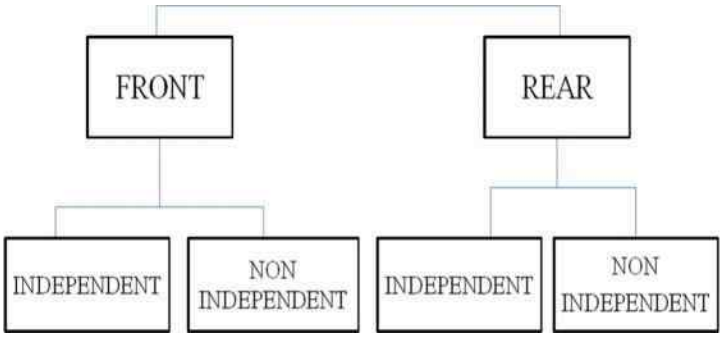
- Frame
- Suspension system
- Steering system
- Tires or Wheels

Components of Suspension system;

There are three fundamental components of any suspension system .

- Spring
  - Coil spring
  - Leaf springs
  - Air springs
- Dampers
  - Shock Absorbers
  - Struts:-
  - Anti-sway Bars
- Anti sway bars.

Types of Suspension system;



Advantages;

- Comfort to passengers
- Good handling
- Shields the vehicle from damage
- Increases life of vehicle
- Keeps the tires pressed firmly to ground.

Braking System;

A brake is a mechanical device which inhibits motion, slowing or stopping a moving object or preventing its motion. The rest of this article is dedicated to various types of vehicular brakes.

Most commonly brakes use friction between two surfaces pressed together to convert the kinetic energy of the moving object into heat, though other methods of energy conversion may be employed. For example regenerative braking converts much of the energy to electrical energy, which may be stored for later use. Other methods convert kinetic energy into potential energy in such stored forms as pressurized air or pressurized oil. Eddy current brakes use magnetic fields to convert kinetic energy into electric current in the brake disc, fin, or rail, which is converted into heat. Still other braking methods even transform kinetic energy into different forms, for example by transferring the energy to a rotating flywheel.

Brakes are generally applied to rotating axles or wheels, but may also take other forms such as the surface of a moving fluid (flaps deployed into water or air). Some vehicles use a combination of braking mechanisms, such as drag racing cars with both wheel brakes and a parachute, or airplanes with both wheel brakes and drag flaps raised into the air during landing.

Since kinetic energy increases elocityan at 10 m/s has 100 times as much energy as one of the same mass moving at 1 m/s, and consequently the theoretical braking distance, when braking at the traction limit, is 100 times as long. In practice, fast vehicles usually have significant air drag, and energy lost to air drag rises quickly with speed. Almost all wheeled vehicles have a brake of some sort. Even baggage carts and shopping carts may have them for use on a moving ramp. Most fixed-wing aircraft are fitted with wheel brakes on the undercarriage. Some aircraft also feature air brakes designed to reduce their speed in flight.

Notable examples include gliders and some World War II-era aircraft, primarily some fighter aircraft and many dive bombers of the era. These allow the aircraft to maintain a safe speed in a steep descent. The Saab B 17 dive bomber and Vought F4U Corsair fighter used the deployed undercarriage as an air brake. Friction brakes on automobiles store braking heat in the drum brake or disc brake while braking then conduct it to the air gradually. When traveling downhill some vehicles can use their engines to brake.

When the brake pedal of a modern vehicle with hydraulic brakes is pushed, ultimately a piston pushes the brake pad against the brake disc which slows the wheel down. On the brake drum it is similar as the cylinder pushes the brake shoes against the drum which also slows the wheel down. Brakes may be broadly described as using friction, pumping, or electromagnetic. One brake may use several principles: for example, a pump may pass fluid through an orifice to create friction: Frictional brakes are most common and can be divided broadly into "shoe" or "pad" brakes, using an explicit wear surface, and hydrodynamic brakes, such as parachutes, which use friction in a working fluid and do not explicitly wear. Typically the term "friction brake" is used to mean pad/shoe brakes and excludes hydrodynamic brakes, even though hydrodynamic brakes usefriction

Friction (pad/shoe) brakes are often rotating devices with a stationary pad and a rotating wear surface. Common configurations include shoes that contract to rub on the outside of a rotating drum, such as a band brake; a rotating drum with shoes that expand to rub the inside of a drum, commonly called a "drum brake", although other drum configurations are possible; and pads that pinch a rotating disc, commonly called a "disc brake".

Other brake configurations are used, but less often. For example, PCC trolley brakes include a flat shoe which is clamped to the rail with an electromagnet; the Murphy brake pinches a rotating drum, and the Ausco Lambert disc brake uses a hollow disc (two parallel discs with a structural bridge) with shoes that sit between the disc surfaces and expand laterally. Pumping brakes are often used where a pump is already part of the machinery. For example, an internal-combustion piston motor can have the fuel supply stopped, and then internal pumping losses of the engine create some braking. Some engines use a valve override called a Jake brake to greatly increase pumping losses. Pumping brakes can dump energy as heat, or can be regenerative brakes that recharge a pressure reservoir called a hydraulic accumulator.

Electromagnetic brakes are likewise often used where an electric motor is already part of the machinery. For example, many hybrid gasoline/electric vehicles use the electric motor as a generator to charge electric batteries and also as a regenerative brake. Some diesel/electric railroad locomotives use the electric motors to generate electricity which is then sent to a resistor bank and dumped as heat.

Types of Braking system in Automobile;

- By applications –
    1. Foot Brake,
    2. Hand brake.
- By Method of power –

1. Mechanical brake,
2. Hydraulic brake.
3. Vacuum brake,
4. Electrical brake and
5. Air brake.

- By method of operations –
  1. Manual brake,
  2. Servo brake.
  3. Power operation.
- By construction –
  1. Drum type brake,
  2. Disc type brake.

Anti-lock braking system (ABS)

Anti-lock braking system (ABS) is an automobile safety system that allows the wheels on a motor vehicle to maintain tractive contact with the road surface according to driver inputs while braking, preventing the wheels from locking up (ceasing rotation) and avoiding uncontrolled skidding. It is an automated system that uses the principles of threshold braking and cadence braking which were practiced by skillful drivers with previous generation braking systems. It does this at a much faster rate and with better control than a driver could manage.

ABS generally offers improved vehicle control and decreases stopping distances on dry and slippery surfaces for many drivers; however, on loose surfaces like gravel or snow-covered pavement, ABS can significantly increase braking distance, although still improving vehicle control.

Since initial widespread use in production cars, anti-lock braking systems have evolved considerably. Recent versions not only prevent wheel lock under braking, but also electronically control the front-to-rear brake bias. This function, depending on its specific capabilities and implementation, is known as electronic brake force distribution(EBD), traction control system, emergency brake assist, or electronic stability control(ESC).

Operation

The anti-lock brake controller is also known as the CAB (Controller Anti-lock Brake). Typically ABS includes a central electronic control unit (ECU), four wheel speed sensors,
and at least two hydraulic valves within the brake hydraulics. The ECU

constantly monitors
the rotational speed of each wheel; if it detects a wheel rotating significantly slower than the others, a condition indicative of impending wheel lock, it actuates the valves to reduce hydraulic pressure to the brake at the affected wheel, thus reducing the braking force on that wheel; the wheel then turns faster.

Conversely, if the ECU detects a wheel turning significantly faster than the others, brake hydraulic pressure to the wheel is increased so the braking force is reapplied, slowing down the wheel. This process is repeated continuously and can be detected by the driver via brake pedal pulsation. Some anti-lock systems can apply or release braking pressure 15 times per second.[17] Because of this, the wheels of cars equipped with ABS are practically impossible to lock even during panic braking in extreme conditions.

The ECU is programmed to disregard differences in wheel rotative speed below a critical threshold, because when the car is turning, the two wheels towards the center of the curve turn slower than the outer two. For this same reason, a differential is used in virtually all roadgoing vehicles. If a fault develops in any part of the ABS, a warning light will usually be illuminated on the vehicle instrument panel, and the ABS will be disabled until the fault is rectified.

Modern ABS applies individual brake pressure to all four wheels through a control system of hub-mounted sensors and a dedicated micro-controller. ABS is offered or comes standard on most road vehicles produced today and is the foundation for electronic stability control systems, which are rapidly increasing in popularity due to the vast reduction in price of vehicle electronics over the years.

Modern electronic stability control systems are an evolution of the ABS concept. Here, a minimum of two additional sensors are added to help the system work: these are a steering wheel angle sensor, and a gyroscopic sensor. The theory of operation is simple: when the gyroscopic sensor detects that the direction taken by the car does not coincide with what the steering wheel sensor reports, the ESC software will brake the necessary individual wheel(s) (up to three with the most sophisticated systems), so that the vehicle goes the way the driver intends. The steering wheel sensor also helps in the operation of Cornering Brake Control (CBC), since this will tell the ABS that wheels on the inside of the curve should brake more than wheels on the outside, and by how much.

ABS equipment may also be used to implement a traction control system (TCS) on acceleration of the vehicle. If, when accelerating, the tire loses traction, the ABS controller can detect the situation and take suitable action so that traction is regained. More sophisticated versions of this can also control throttle levels and brakes simultaneously.

Components of ABS

There are four main components of ABS:

- Speed sensors,
- Valves,
- Pump, and
- Controller.

Speed sensors

A speed sensor is used to determine the acceleration or deceleration of the wheel. These sensors use a magnet and a coil of wire to generate a signal. The rotation of the wheel or differential induces a magnetic field around the sensor. The fluctuations of this magnetic field generate a voltage in the sensor. Since the voltage induced in the sensor is a result of the rotating wheel, this sensor can become inaccurate at slow speeds. The slower rotation of the wheel can cause inaccurate fluctuations in the magnetic field and thus cause inaccurate readings to the controller.

Valves

There is a valve in the brake line of each brake controlled by the ABS. On some systems, the valve has three positions:

In position one, the valve is open; pressure from the master cylinder is passed right through to the brake.

In position two, the valve blocks the line, isolating that brake from the master cylinder. This prevents the pressure from rising further should the driver push the brake pedal harder.

In position three, the valve releases some of the pressure from the brake.

The majority of problems with the valve system occur due to clogged valves. When a valve is clogged it is unable to open, close, or change position. An inoperable valve will prevent the system from modulating the valves and controlling pressure supplied to the brakes.

Pump

The pump in the ABS is used to restore the pressure to the hydraulic brakes after the valves have released it. A signal from the controller will release the valve at the detection of wheel slip. After a valve release the pressure supplied from the user, the pump is used to restore a desired amount of pressure to the braking system. The controller will modulate the pumps status in order to provide the desired amount of pressure and reduce slipping.

Controller

The controller is an ECU type unit in the car which receives information from each individual wheel speed sensor, in turn if a wheel loses traction the signal is sent to the controller, the controller will then limit the brake force (EBD) and activate the ABS modulator which actuates the braking valves on and off.

Use

There are many different variations and control algorithms for use in ABS. One of the simpler systems works as follows,

The controller monitors the speed sensors at all times. It is looking for decelerations in the wheel that are out of the ordinary. Right before wheel locks up, it will experience a rapid deceleration.

If left unchecked, the wheel would stop much more quickly than any car could. It might take a car five seconds to stop from 60 mph (96.6 km/h) under ideal conditions, but a wheel that locks up could stop spinning in less than a second.

The ABS controller knows that such a rapid deceleration is impossible, so it reduces the pressure to that brake until it sees an acceleration, then it increases the pressure until it sees the deceleration again. It can do this very quickly, before the tire can actually significantly change speed. The result is that the tire slows down at the same rate as the car, with the brakes keeping the tires very near the point at which they will start to lock up. This gives the system maximum braking power.

This replaces the need to manually pump the brakes while driving on a slippery or a low traction surface, allowing steering even in the most emergency braking conditions.

When the ABS is in operation the driver will feel a pulsing in the brake pedal; this comes from the rapid opening and closing of the valves. This pulsing also tells the driver that the ABS has been triggered. Some ABS systems can cycle up to 16 times per second.

Hydraulic braking system

The disc brake or disk brake is a device for slowing or stopping the rotation of a wheel while it is in motion. A brake disc (or rotor in U.S. English) is usually made of cast iron, but may in some cases be made of composites such as reinforced carbon-carbon or ceramic-matrix composites.

This is connected to the wheel and/or the axle. To stop the wheel, friction material in the form of brake pads (mounted on a device called a brake caliper) is forced mechanically, hydraulically, pneumatically or electromagnetically against both sides of the disc. Friction causes the disc

and attached wheel to slow or stop. Brakes (both disc and drum) convert motion to heat, but if the brakes get too hot, they will become less effective because they cannot dissipate enough heat. This condition of failure is known as brake fade.

Construction of Braking system;

The most common arrangement of hydraulic brakes for passenger vehicles, motorcycles, scooters, and mopeds, consists of the following:

- Brake pedal or lever
- A pushrod (also called an actuating rod)
- A master cylinder assembly containing a piston assembly
- Reinforced hydraulic lines

Brake caliper assembly usually consisting of one or two hollow aluminum or chrome-plated steel pistons (called caliper pistons), a set of thermally conductive brake pads and a rotor (also called a brake disc) or drum attached to an axle.The system is usually filled with a glycol-ether based brake fluid (other fluids may also be used).

At one time, passenger vehicles commonly employed drum brakes on all four wheels. Later, disc brakes were used for the front and drum brakes for the rear. However disc brakes have shown better heat dissipation and greater resistance to 'fading' and are therefore generally safer than drum brakes. So four-wheel disc brakes have become increasingly popular, replacing drums on all but the most basic vehicles. Many two-wheel vehicle designs, however, continue to employ a drum brake for the rear wheel.The following description uses the terminology for and configuration of a simple

.

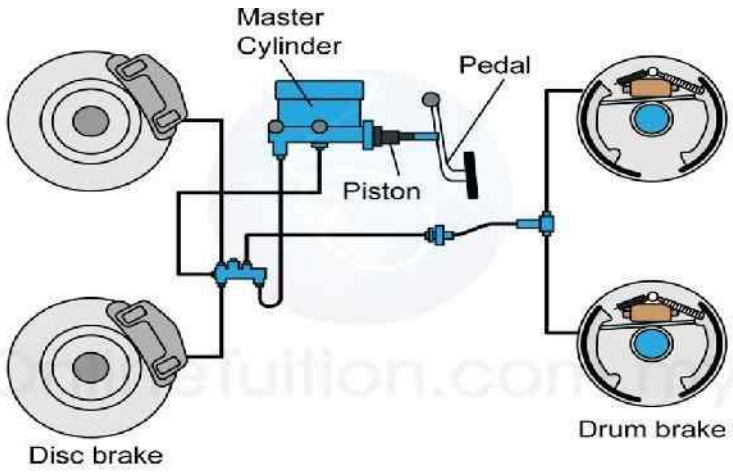
In a hydraulic brake system, when the brake pedal is pressed, a pushrod exerts force on the piston(s) in the master cylinder, causing fluid from the brake fluid reservoir to flow into a pressure chamber through a compensating port. This results in an increase in the pressure of the entire hydraulic system, forcing fluid through the hydraulic lines toward one or more calipers where it acts upon one or two caliper pistons sealed by one or more seated O-rings (which prevent leakage of the fluid).

The brake caliper pistons then apply force to the brake pads, pushing them against the spinning rotor, and the friction between the pads and the rotor causes a brakingtorque to be generated, slowing the vehicle. Heat generated by this friction is either dissipated through vents and channels in the rotor or is conducted through the pads, which are made of specialized heat-tolerant materials such as kevlar orsintered glass.

Subsequent release of the brake pedal/lever allows the spring(s) in my

master cylinder assembly to return the master piston(s) back into position. This action first relieves the hydraulic pressure on the caliper, then applies suction to the brake piston in the caliper assembly, moving it back into its housing and allowing the brake pads to release the rotor.

The hydraulic braking system is designed as a closed system: unless there is a leak in the system, none of the brake fluid enters or leaves it, nor does the fluid get consumed through use.



Pneumatic braking system

An air brake or, more formally, a compressed air brake system, is a type of friction brake for vehicles in which compressed air pressing on a piston is used to apply the pressure to the brake pad needed to stop the vehicle.

Air brakes are used in large heavy vehicles, particularly those having multiple trailers which must be linked into the brake system, such as trucks, buses, trailers, and semi-trailers in addition to their use in railroad trains.

George Westinghouse first developed air brakes for use in railway service. He patented a safer air brake on March 5, 1872. Westinghouse made numerous alterations to improve his air pressured brake invention, which led to various forms of the automatic brake. In the early 20th century, after its advantages were proven in railway use, it was adopted by manufacturers of trucks and heavy road vehicles.

Construction of Braking system;

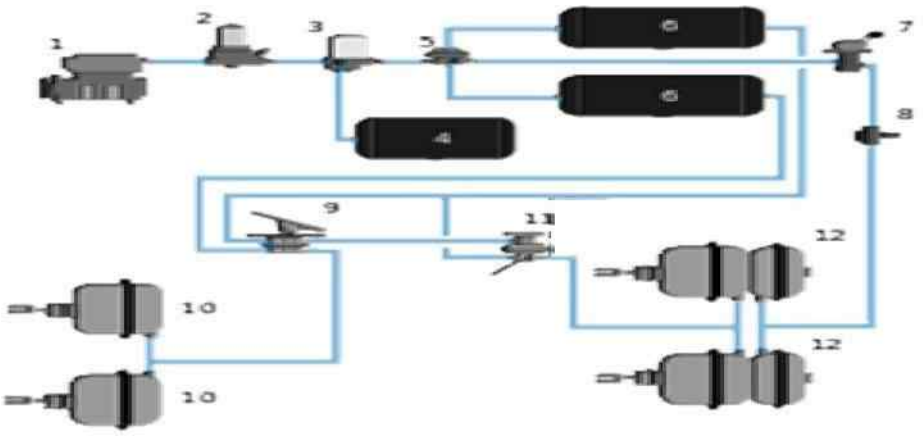
Air brake systems are typically used on heavy trucks and buses. The system consists of service brakes, parking brakes, a control pedal, and an air storage tank. For the parking brake, there is a disc or drum brake

arrangement which is designed to be held in the 'applied' position by spring pressure.

Air pressure must be produced to release these "spring brake" parking brakes. For the service brakes (the ones used while driving for slowing or stopping) to be applied, the brake pedal is pushed, routing the air under pressure (approx 100–120 psi or 690–830 kPa) to the brake chamber, causing the brake to be engaged. Most types of truck air brakes are drum brakes, though there is an increasing trend towards the use of disc brakes in this application. The air compressor draws filtered air from the atmosphere and forces it into high-pressure reservoirs at around 120 psi (830 kPa).

Most heavy vehicles have a gauge within the driver's view, indicating the availability of air pressure for safe vehicle operation, often including warning tones or lights. Setting of the parking/emergency brake releases the pressurized air in the lines between the compressed air storage tank and the brakes, thus allowing the spring actuated parking brake to engage. A sudden loss of air pressure would result in full spring brake pressure immediately.

A compressed air brake system is divided into a supply system and a control system. The supply system compresses, stores and supplies high-pressure air to the control system as well as to additional air operated auxiliary truck systems (gearbox shift control, clutch pedal air assistance servo, etc.).



Highly simplified air brake diagram on a commercial road vehicle (does not show all air reservoirs and all applicable air valves). The air compressor is driven by the engine either by crankshaft pulley via a beltor directly from the engine timing gears. It is lubricated and cooled by the engine lubrication and cooling systems.

Compressed air is first routed through a cooling coil and into an air dryer which removes moisture and oil impurities and also may include a pressure regulator, safety valve and smaller purge reservoir. As an alternative

to the air dryer, the supply system can be equipped with an anti-freeze device and oil separator. The compressed air is then stored in a reservoir (also called a wet tank) from which it is then distributed via a four way protection valve into the front and rear brake circuit air reservoir, a parking brake reservoir and an auxiliary air supply distribution point. The system also includes various check, pressure limiting, drain and safety valves.Air brake systems may include a wig wag device which deploys to warn the driver if the system air pressure drops too low.

Control system

The control system is further divided into two service brake circuits: the parking brake circuit and the trailer brake circuit. This dual brake circuit is further split into front and rear wheel circuits which receive compressed air from their individual reservoirs for added safety in case of an air leak. The service brakes are applied by means of a brake pedal air valve which regulates both circuits.

The parking brake is the air operated spring brake type where its applied by spring force in the spring brake cylinder and released by compressed air via hand control valve. The trailer brake consists of a direct two line system: the supply line (marked red) and the separate control or service line (marked blue). The supply line receives air from the prime mover park brake air tank via a park brake relay valve and the control line is regulated via the trailer brake relay valve. The operating signals for the relay are provided by the prime mover brake pedal air valve, trailer service brake hand control (subject to a country's relevant heavy vehicle legislation) and the prime mover park brake hand control.

Advantages of Air Brakes;

Air brakes are used as an alternative to hydraulic brakes which are used on lighter vehicles such as automobiles. Hydraulic brakes use a liquid (hydraulic fluid) to transfer pressure from the brake pedal to the brake shoe to stop the vehicle. Air brakes have several advantages for large multitrailer vehicles:

- The supply of air is unlimited, so the brake system can never run out of its operating fluid, as hydraulic brakes can. Minor leaks do not result in brake failures.
- Air line couplings are easier to attach and detach than hydraulic lines; there is no danger of letting air into hydraulic fluid. So air brake circuits of trailers can be attached and removed easily by operators with little training.
- Air not only serves as a fluid for transmission of force, but also stores potential energy. So it can serve to control the force applied. Air brake systems include an air tank that stores sufficient energy to stop the vehicle if the compressor fails.
- Air brakes are effective even with considerable leakage, so an air brake

system can be designed with sufficient "fail-safe" capacity to stop the vehicle safely even when leaking.

Question Bank

VEHICLE STRUCTURE AND ENGINES

PART-A

1. What is meant by self-propeller vehicle?
   A vehicle producing power within itself for its propulsion is known as self-propeller vehicle.

2. What is built by Karl Benz? State its significance.
   Karl Benz of Germany built a tricycle with an I.C. engine in 1885-86 which was working an Otto cycle. The speed of the engine was 10mph. and produced 8.H.P.

3. Mention the various products of scooters India Ltd.
   Vijay deluxe, Vijay super, Lambretta cento 100 scooters are manufactured by them.

4. Give any four world's leading automobiles manufacturers.
   1. Toyota
   2. Nissan
   3. Hyundai
   4. Mercedes Benz Ltd.
5. State the major types of automobiles according to the fuel used.
   (a) Petrol vehicles
   (b) Diesel vehicles
   (c) Gas vehicles
   (d) Electric vehicles
   (e) Solar vehicles
6. Classify automobiles with respect to the drive of the vehicle.
   1. Left hand drive
   2. Right hand drive
7. How automobiles are streamlined based on transmission?
   a) Conventional automobiles
   b) Semi-automatic automobiles
   c) Automatic automobiles.
8. Give any four names for the automobiles.
   i) Motor vehicles
   ii) Motor coach

iii) Motor wagon
iv) Horseless carriage

9. Mention the various parts of a car.

   Generator, starter, steering, clutch, rear axle, differential, universal joints, wheel, tyres, body, lamp etc.

10. Define lift force.

    Aerodynamic lift force is the vertical

    component of the resultant force caused by the pressure distribution on the body.

11. Why are rings provided on piston?

    They are used to maintain air tight sealing between piston and cylinder to prevent gas leakage.

12. What are the methods of cooling in IC engines?
    1. Air cooling
    2. Water cooling

13. What are the types of water cooling?
    a. Thermosymphon system
    b. Pump circulation system

14. What is meant by lubrication?

The process of reducing the friction between moving parts is known as lubrication.

15. What is EGR?

    The form of excessive nitrogen oxides due to peak combustion temperature which is greater than $1950^{o}c$ is known as EGR.

PART-B

1. Describe the brief history of the automobile.
2. Classify automobiles.
3. Explain the various forces acting on the body and its aerodynamic affects.
4. What are the different types of cooling system and explain any two in detail.

ENGINE AUXILIARY SYSTEM

PART-A

1. What is carburetor?

   The carburetor is a device used for atomizing and vaporizing the fuel and mixing it with the air in varying proportions to suit the changing operating conditions of vehicle engines.

2. What is meant by carburetion?

The process of breaking up and mixing the fuel with the air is called carburetion.

3. Define the terms vaporization and atomization.

   Vaporization is a change of state of fuel from a liquid to a vapor.

   Atomization is a mechanical breaking up of the liquid into small particles so that every minute particle of the fuel is surrounded by the air.

4. What does a mixing chamber do?

   The mixing chamber has two butterfly valves. One is to allow air into the mixing chamber and known as choke valve. The other is to allow air- fuel mixture to the engine and known as throttle valve.

5. Mention the different circuits involved in solex carburetor?
   a. Float circuit
   b. Starting circuit
   c. Idle and low speed circuit
   d. Normal running circuit
   e. Acceleration circuit
6. Give few models of zenith carburetor.
   i) Zenith VE type carburetor
   ii) Zenith stromberg carburetor
   iii) Zenith 30 VIG II carburetor
   iv) Zenith NV type carburetor
   v) Zenith DBE type carburetor
   vi) Zenith WIA type carburetor etc.
7. State the carburetor trouble shooting according to poor engine pickup.

Sl. No.	**Causes**	**Remedies**
1.	Obstructed main jet.	Clean the main jet.
2.	Obstruction in emulsion.	Clean the tube.
3.	Defect in acceleration pump.	Clean the pump.

8. State the important units of electric fuel injection system.
   1. Fuel delivery system
   2. Air induction system
   3. Sensors and air flow control system
   4. Electronic control unit
9. List any two batteries used in automobiles.
   i. Lead acid battery
   ii. Alkaline battery
10. Define battery life.

The duration of the battery is up to the discard from starting of operation in any places.

11. List the factors affecting the battery life.
    1. Electrolyte level
    2. Overcharging
    3. Corrosion
    4. Sluphation
    5. Mounting etc.
12. Define cycling.

    Cycling is the process of discharging and charging of the battery.

13. Name the two types of alkaline battery.
    1. Nickel-iron type
    2. Nickel-cadmium type
14. What is the purpose of Cut-out relay?

    It prevents the reverse flow of current from the battery to the generator.

15. What does generator and motor do?

    The generator converts mechanical energy into electrical energy whereas the motor converts electrical energy into mechanical energy.

PART-B

1. Sketch and explain the construction and operation of a simple carburetor.
2. Explain the principle of operation of a carburetor used in two wheelers with a sketch.
3. Explain the trouble shooting of carburetor.
4. Draw a typical ignition coil and name the parts.
5. Explain with a sketch the working of an electronic fuel injection system (any one type).

TRANSMISSION SYSTEMS

PART-A

1. State the functions of transmission system.
    i. It enables the running engine to be connected or disconnected from the driving wheel smoothly.
    ii. It enables the reduction of engine speeds.
    iii. It enables the turn of the drive round through 90^{o}.
    iv. It enables the driving wheel to be driven at different speeds.

2. What is a clutch?

   Clutch is a mechanism used to connect or disconnect the engine from the rest of the transmission elements.

3. List the various parts of a single plate clutch.
   1. Fly wheel
   2. Clutch plate
   3. Pressure plate
   4. Clutch cover assembly
   5. Release mechanism
   6. Withdrawal force and rearing
   7. Primary shaft

4. Why multi-plate clutches are used in automobiles?

   As compared to single plate clutch, these are smoother and easier to operate due to their assembly of friction surfaces contact.

5. Give the two types of multi-plate clutches.
   a. Wet type and b. Dry type
6. How is dog and spline clutch disengaged?

   The sleeve is moved back on the splined shaft to have no contact with the driving shaft.

7. What do you mean by fluid flywheel?

   The member which couples the driving member with driven member through a media of fluid is known as fluid coupling.

8. What is the function of a gearbox?

   Gearbox is a speed and torque changing device.

9. List out the various resistances to motion.
   1. Air resistances
   2. Gradient resistances
   3. Miscellaneous resistances
10. Define tractive effort.

    The torque available on the wheel produces a driving force which is parallel to the road is known as tractive effort.

11. Why is double clutching technique used?

    Even though there is no measure to allow easy measuring of gears, “double clutching” technique must be acquired for shifting gears properly.

12. Write down the methods of operating automatic gearbox.
    1. Hydramatic transmission
    2. Torque converter transmission

13. Name the two types of propeller shafts.
    1. Solid or open type
    2. Hollow or enclosed type
14. Classify universal joints.
    a. Variable velocity joints
    b. Constant velocity joints
15. List down the types of liver rear axles.
    1. Semi-floating
    2. Three-quarter floating
    3. Full-floating

PART-B

1. What is meant by clutch? List out the requirements.
2. Explain the working of a single plate clutch with a diagram.
3. Explain the sliding mesh gearbox with a suitable sketch.
4. Explain the principle and working of a differential with a neat sketch.
5. What are the functions of a Hotchkiss drive? Compare its merits with torque tube drive.

STEERING, BREAKS AND SUSPENSION

PART-A

1. How is power developed in automobiles?
   The power is transferred to rear axle through clutch, gearbox, propeller shaft and differential unit.

2. Classify wheels.
   a. Disc wheel
   b. Wire wheel
   c. Split wheel
   d. Light alloy wheel
3. Write down the types of tread patterns in tyres.
   a. Rib pattern
   b. Lug pattern
   c. Rib-and-Lug pattern
   d. Block pattern
4. What is meant by the term ‘tread’?
   The tread is an external rubber layer preventing the carcass from wear and external damage which are produced by the road surface.

5. State the important parameters in radial type.
   1. Performance of the tyre

2. Shape of the tyre

6. Name the various materials used in manufacturing of tyres.
    i. Nylon
    ii. Terylene
    iii. Rubber
    iv. Glass fiber
    v. Steel
7. Write down the basic constituents of a tyre.
    1. Rubber – natural or synthetic
    2. Nylon or Rayon cord fabric
    3. Steel
8. What are the inspecting methods used in tyres?
    1. Visual inspection
    2. Thorough inspection.
9. Describe 154 SR-14 in tyre designation.

    The code 154 SR-14 refers to the tyre having speed rating upto 170kmph of radial tyre and the width of W=154mm with D=14inches.

10. Define tube vulcanization.

The process of repairing a punctured tube is known as tube vulcanization

11. What is meant by camel block?

    Fresh tread material is known as 'Camel Block' is placed around the tread and put in
    retreading machine and clamped.

12. What is wheel balancing?

    Balancing the wheel assemblies correctly to avoid such vibration is known as wheel balancing.

13.

1. Static balance
2. Dynamic balance

14. Classify air suspension system.
    a. Bellow type air suspension
    b. Piston type air suspension
15. State Pascal's law.

    It states that the total pressure acting on the transmission system is equal to the sum of pressures acting in all directions without any losses.

PART-B

1. What are the different types of wheels? Discuss their relative merits.
2. What are the different types of steering gears used in an automobile?

3. Explain the rack and pinion steering system of an automobile.
4. Explain the operation of a telescopic type shock absorber with a sketch.
5. Explain the working of Disc brake system.

Automobile Ebgineering - Question Bank

1. .What are the functions of frame?
2. List out the various materials used in the construction of chassis frames.
3. Write down any two main sections of vehicle construction.
4. What are two types of vehicle suspensions?
5. What loads are coming to axle?
6. What is the function of gear box?
7. Why you need a gear box?
8. Name the different kind of resistances to vehicle motion
9. Why is the frame narrow at front?
10. List out the various materials used in the construction of vehicle body
11. Why are the side members of the frame upswept at two places?
12. What is the function of a bumper?
13. What are the stresses to which the frame members are subjected to?
14. Name few components of engine.
15. What are the types of frames?

Part B

16. Compare the merits and demerits of a frameless construction with those of the conventional framed construction.
17. Explain the following terms:
(i) Load distribution in frames (ii) Frame types with sketch
18. Explain the construction of various frames used in automobiles with neat sketch.
19. (i) Define chassis, frame, body and suspension.
(ii) Explain briefly about structure of passenger car with neat sketch.
20. (i) Discuss the various resistances to vehicle motion ii) Discuss the need of a gear box.
21. Explain any five components of engine with neat sketch.
22. Explain the materials used to manufacture the components of engine
23. Explain briefly the various types of chassis construction with suitable diagrams.
24. Discuss briefly the details of a two wheeler frame.
25. Explain integral and semi integral type vehicle body construction.

1. What is gasoline injection?

2. What is conventional ignition system?
3. Define common rail ignition system..
4. What is unit injection system?
5. What is a rotary distributor?
6. What are the functions of a spark plug?
7. Write is Electronic ignition system?
8. What is the functions of Turbo chargers?
9. Why the . Engine emissions to be controlled?
10. What are the advantages of petrol injection?
11. What is super charging?
12. What are the pollutants emitted by automobile?

Part B

1. Explain the working principle of electronic ignition system
2. Discuss the merits and demerits of electronic ignition system
3. With a suitable sketch, explain the Electronically controlled gasoline injection system
4. With a neat sketch, explain the Electronically controlled diesel injection system.
5.. Explain the turbo charging system with neat sketch.
6. What is 3 way catalytic converter? Explain its working principle.
7. Explain common rail direct injection system with neat sketch.
8. Explain the Unit injector system with neat sketch.

1. State the functions of clutch.
2. What is the function of pressure plate in a clutch?
3. What are the different types of clutches?
4. Write the main function of gear box.
5. What are the functions of universal joint?
6. State the function of differential unit.
7. What is meant by differential lock?
8. What is a fluid coupling?
9. State the functions of slip joint.
10. What is the function of a propeller shaft?
11. What are the requirements of an automotive transmission?
12. What are the requirements of a clutch?
13. What are the types of gear box?
14. What is the use of torque convertor?

15. State the forces act on the rear axle.

Part B

16. (i) Explain the working principle of torque tube drive with neat sketch.
(ii) Explain the working principle of hotch kiss drive with neat sketch.
17. Explain the construction and working principle of a typical gear box
18. (i) What is a clutch? Explain the operation of centrifugal clutch.
(ii) Explain the working principle of synchromesh gear box with neat sketch.
(i) Explain the types of rear axles with neat sketch.
)(ii) What is the necessity of a gear box?
19. Explain the working principle of fluid flywheel with neat ske
tch and also mention the limitations.
20. Explain the single plate clutch and multiplate clutch with neat sketch.
21. (i) Explain the working of sliding mesh gear box with neat sketch.
(ii) Explain the working of a cone clutch. (i) Explain the working of a constant mesh gear box.
(ii) Explain the working of universal joint with neat sketch.
22. (i) Explain the working of epicyclic gear box with neat sketch.
(ii) Compare fluid coupling and torque convertor.
23. Explain the construction and working of a differential unit with neat sketch.
24. Explain the principle of working of torque convertor with neat sketch.

PART - A

1. Define wheel track and wheel base.
2. Give a brief note on damper.
3. Distinguish between disc brake with drum brake.
4. What is meant by bleeding of brakes?
5. Define steering gear.
6. What are the four types of wheels?
7. What is the purpose of Toe -in and Toe-out?
8. What are the different types of tyres used in automobile?
9. What are the different types of springs used in suspension system?
10. Define king pin inclination.
11. Give the function of tyre?
12. Define caster and camber.
13. What are the benefits of anti -lock brake system?

Part B

14. (i) Sketch and explain various steering geometries.

(ii) Explain with the help of simple diagram the different typas of stub axles.

15. Explain the working principles of hydraulic brake with neat sketch.

16. 16 (i) Explain a typical power steering system.

(ii) Explain the wheel ali gnment system.

17. (i) Explain any one type of steering gear box with neat sketch.

(ii) What is the necessity of a steering gear?

18. Explain the steering geometry with neat sketch.

19 Explain the working of power steering with neat sketch

20. (i) Explain the Ackerman principle of steering with neat sketch.

(ii) Explain the working of torsion bar with neat sketch.

21 (i) Explain the working of rear independent suspension system with neat sketch.

(ii) Explain the working of front independent suspension system with neat sketch.

22. (i) Explain the working of shock absorber with neat sketch.

(ii) What are the objectives and components of suspension system.

23. Explain the mechanical brakes with neat sketch.

24. Explain the pneumatic or air brakes with neat sketch.

1. List the advantages of hydrogen fuel used in automobiles.
2. What is a hybrid vehicle?
3. What is a fuel cell?
4. Write the composition of LPG and CNG.
5. Define detonation and pre-ignition.
6. What is the need for CNG?
7. What are the advantages of an electric car?
8. What are the advantages of hybrid system?
9. State the advantages of fuel cell.
10. What are the types of fuel cell?

Part B

11. How bio diesel is produced? Explain and its usage in automobiles.
12. Explain the operation of hydrogen fueled vehicle with neat sketch.
13. Explain the working principle of fuel cell with neat sketch.
14. Discuss the operation of an LPG propelled vehicle with neat sketch.
15. Explain the concept of hybrid vehicles with neat sketch.

(i) Explain the usage of gasohol fuel in automobiles.

(ii) Explain the working of an electric car.

SHORT TYPE

1. What are the functions of a frame?

To support the chassis components and the body.
To withstand static and dynamic loads without undue deflection or distortion.
To carry the load of the passengers or goods carried in the body.

2 What are the stresses to which the frame members are subjected to?

Frame longitudinal members – bending stress•
Frame side members – twisting stress•

3. Name few components of engine.

1. Cylinder blocks
2. Cylinder head
3. Crankcase
4. Cylinder
5. Piston
6. Connecting rod
7. Crankshaft
8. Camshaft Valves Spark plug (in the case of petrol engine)
9. Fuel injector (in the case of diesel engine)

4. What is meant by the term Chassis?

A
complete vehicle without a body structure is known as Chassis. It comprises of basic structure, power unit, transmission system, controls and auxiliaries.

5.The main components of an automobile refer to the following components

Frame,• Chassis,• Body,• Power unit,• Transmission system•

6. What is the function of clutch? The function of the clutch is to connect and disconnect the engine with road wheels. The clutch has to be disengaged during gear shifting, idling etc. .

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LECTURE IN MECHANICAL ENGG.