IV/IV B. Tech (Regular) DEGREE EXAMINATION April'2023

Mechanical Engineering

Institutional Elective

Automobile Engineering (18MEI04)

(Common to all branches except Mechanical Engineering)

Scheme of Evaluation cum Answers

18MEI04

Hall Ticket Number:

IV/IV B.Tech (Supplementary) DEGREE EXAMINATION

April, 2023 **Institutional Elective (Common to all branches)**

Eighth Semester **Automobile Engineering**

Time: Three Hours **Maximum:** 50 Marks

Answer Question No.1 compulsorily. (10X1 = 10 Marks)

Answer ONE question from each unit. (4X10=40 Marks)

1	a)	List the functions of a Fuel supply pump in an automobile	CO1	L2	
	b)	Explain the function of Flywheel	CO1	L1	
	c)	Mention the two-firing order of a 4-cylinder engine	CO1	L2	
	d)	List out the accessories works in an automobile	CO2	L3	
	e)	What is the use of starting motor in an automobile	CO2	L2	
	f)	List out the function of differential in an automobile	CO2	L1	
	g)	Explain the need for suspension systems	CO3	L4	
	h)	What is meant by wheel alignment	CO3	L2	
	i)	List out the advantages of electrical vehicles	CO4	L3	
	j)	What is the advantages of power density batteries in an automobile	CO4	L1	
		Unit -I			
2	a)	Explain the working of Mechanical type Diaphragm Pumps with a neat sketch	CO1	L2	5M
	b)	Illustrate the Forced Circulation cooling systems with neat sketch	CO1	L1	5M
		(OR)			
3	a)	What are the different valve operating Mechanisms and explain any one mechanism with neat sketch	CO1	L3	5M
	b)	What is the function of Fuel Filters and explain any one Fuel Filters with neat sketch	CO1	L2	5M
		Unit -II			
4	a)	What are the Electronic Ignition and explain its merits and demerits	CO2	L3	5M
	b)	Explain the function of Distributor type ignition system with a neat sketch	CO2	L2	5M
		(OR)			
5	a)	Explain the splash lubrication system with a neat sketch	CO2	L1	5M
	b)	Explain about Wet sump lubrication system with a neat sketch	CO2	L3	5M
		Unit -III			
6	a)	Explain the construction and working principle of Sliding Mesh type gear box	CO3	L4	5M
	b)	What is the function of propeller shaft.	CO3	L2	5M
		(OR)			
7	a)	Explain the elements of Suspension system.	CO3	L3	5M
	b)	What is the need of suspension systems in an automobile.	CO3	L1	5M
		Unit -IV			
8	a)	Explain brake actuation mechanisms mechanism with a neat sketch	CO4	L1	5M
	b)	Explain the working principle of Hydraulic braking system with a neat sketch	CO4	L2	5M
		(OR)			
9	a)	What are the advantages and disadvantages of using electrical vehicles	CO4	L4	5M
	b)	Illustrate the hybrid vehicle layout and list out its advantages and disadvantages	CO4	L3	5M

Scheme of Evaluation

1	a)	List the functions of a Fuel supply pump in an automobile	1M
	b)	Explain the function of Flywheel	1M
	c)	Mention the two-firing order of a 4-cylinder engine	1M
	d)	List out the accessories works in an automobile	1M
	e)	What is the use of starting motor in an automobile	1M
	f)	List out the function of differential in an automobile	1M
	g)	Explain the need for suspension systems	1M
	h)	What is meant by wheel alignment	1M
	i)	List out the advantages of electrical vehicles	1M
	j)	What are the advantages of power density batteries in an automobile	1M
		Unit -I	
2	a)	Explain the working of Mechanical type Diaphragm Pumps with a neat sketch. *Sketch-2M* *Explanation-3M*	5M
	b)	Illustrate the Forced Circulation cooling systems with neat sketch. *Sketch-2M* *Explanation-3M*	5M
		(OR)	
3	a)	What are different types of valve operating Mechanisms and explain any one mechanism with neat sketch. *List-1M* *Sketch-2M* *Explanation-2M*	5M
	b)	What is the function of Fuel Filters and explain any one Fuel Filters with neat sketch? *Functions-1M* *Sketch-2M* *Explanation-2M*	5M
		Unit -II	
4	a)	What is the Electronic Ignition and explain its merits and demerits? *Definition-1M* *Merits-2M* *Demerits-2M*	5M
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5	a)	Explain the splash lubrication system with a neat sketch. *Sketch-2M* *Explanation-3M*	5M
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		Unit -III	
6	a)	Explain the construction and working principle of Sliding Mesh type gear box. *Sketch-2M* *Construction & Working-3M*	5M
	b)	What is the function of propeller shaft. *Sketch-1M* *Functions-4M*	5M
		(OR)	
7	a)	Explain the elements of Suspension system. *Explanation of the elements-5M*	5M
	b)	What is the need of suspension systems in an automobile. *Explanation of the need-5M*	5M

Unit -IV			
8	a)	Explain brake actuation mechanisms mechanism with a neat sketch. *List-2M* *Explanation of anyone-3M*	5M
	b)	Explain the working principle of Hydraulic braking system with a neat sketch. *Sketch-2M* *Construction & Working-3M*	5M
(OR)			
9	a)	What are the advantages and disadvantages of using electrical vehicles? *Advantages-3M* *Disadvantages-2M*	5M
	b)	Illustrate the hybrid vehicle layout and list out its advantages and disadvantages. *Layout-2M* *Advantages & Disadvantages-3M*	5M

IV/IV B. Tech (Regular) DEGREE EXAMINATION April'2023

Mechanical Engineering

Automobile Engineering (18MEI04)

Detailed Scheme of Evaluation

Max. Marks: 50

1.

a) List the functions of a Fuel supply pump in an automobile.
Ans: The purpose of a car fuel pump is to convey the required quantity of fuel from the tank to the engine at the necessary pressure.

b) Explain the function of Flywheel.
Ans: The function of the flywheel is to store mechanical energy to balance the engine so that it continues to have good performance.

c) Mention the two-firing order of a 4-cylinder engine.
Ans: Straight-four engines typically use a firing order of 1-3-4-2, or 1-4-3-2.

d) List out the accessories works in an automobile.
Ans: Accessories like GPS Navigation Systems, surround sound systems, front/rear view mirrors, air fresheners, mobile phone holders, car covers, seat covers, puncture repair kits, tire inflators, pressure gauges, etc. make car rides more fun, safe, and convenient.

e) What is the use of starting motor in an automobile?
Ans: The starter motor is responsible for turning the engine over during ignition and allowing everything else to happen.

f) List out the function of differential in an automobile.
Ans: The function of a differential is to transmit power from the engine to the axle that moves the wheels and allow the wheels to move at different speeds from each other.

g) Explain the need for suspension systems.
Ans: Suspension systems helps ensure that your drive is safe and smooth by absorbing the energy from various road bumps and other kinetic impacts.

h) What is meant by wheel alignment?
Ans: Wheel alignment refers to the angle of your wheels in comparison to each other and the body of your vehicle.

i) List out the advantages of electrical vehicles.
- No fuel required so you save money on gas. ...
- Environmentally friendly as they do not emit pollutants. ...
- Lower maintenance due to an efficient electric motor. ...
- Better Performance.

j) What are the advantages of power density batteries in an automobile?
Ans: Power density allows more power to be processed in a smaller space while enhancing the functionality of a system at reduced, not increased, system costs.

2 a) Explain the working of Mechanical type Diaphragm Pumps with a neat sketch.

It consists of a diaphragm, above which, there is a chamber. The diaphragm is connected to a pull rod, which is spring loaded. The pull rod is connected to a rocker arm with a pivot at the center. The rocker arm is placed near the eccentric connected to the engine cam shaft. The chamber has two valves, suction, and pressure valves, among which only one valve will open at a time. The suction valve is connected to the inlet from the fuel tank and pressure valve is connected to outlet of the pump to carburetor.

When the eccentric operates the rocker arm, the pull rod moves down against the spring and the diaphragm also flexes downwards. Due to this, the pressure inside the chamber reduces and suction valve opens, and fuel enters the chamber. When the eccentric releases the rocker arm, the pull rod moves up due to spring force and

the volume of the chamber decreases, which increases the pressure of the fuel, and the pressure valve opens. The fuel moves out of the pump to carburetor.

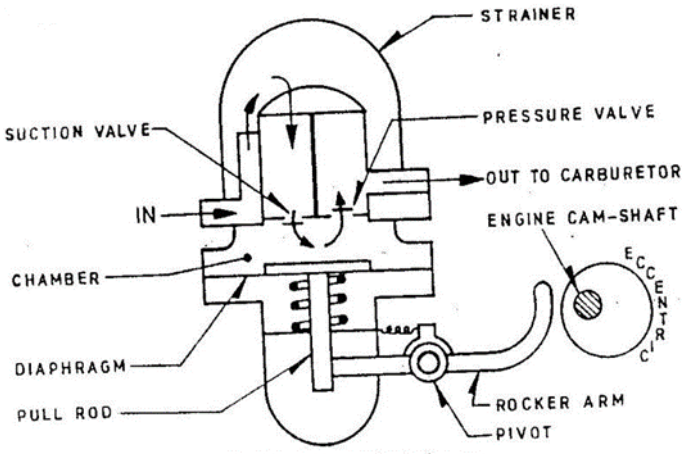


Fig. 8.2. A.C. Mechanical pump.

b) Illustrate the Forced Circulation cooling systems with neat sketch

Pump Circulation system:

It consists of a pump for circulation of coolant and a thermostat is employed to control the flow of coolant. The pump is driven by means of belt from the engine crank shaft.

ADVANTAGES:

1. The circulation of coolant is proportional to both load and speed.
2. Circulation of coolant is positive and hence more efficient.
3. The radiator need not be placed in front.
   - However, this is more complicated and costlier than thermosyphon system

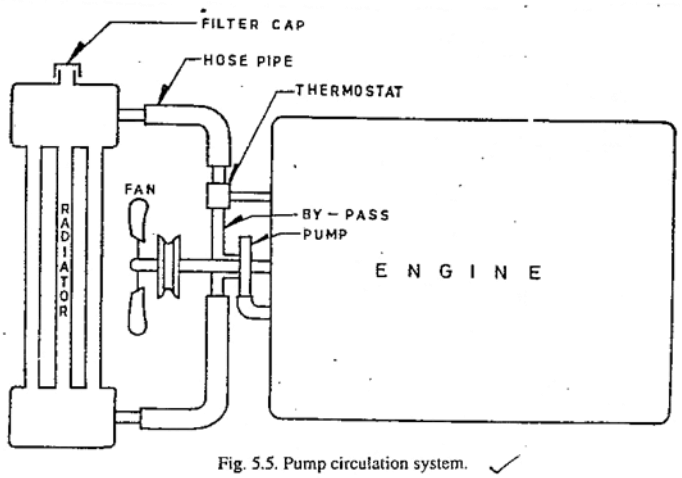


Fig. 5.5. Pump circulation system.

(OR)

3 a) What are the different valve operating Mechanisms and explain any one mechanism with neat sketch.

Types of Valve Operating Mechanism

- Side valve mechanism
- Overhead mechanism

1. Side Valve Mechanism

In this mechanism as shown in the figure, the inlet valve is placed on the side of the cylinder valve. When the camshaft rotates the cam, the lobe opens the valve directly through the tappet against the spring's tension. When the cam lobe attains the maximum height, the valve opens completely. Additional rotation of the cam triggers the tappet to move downwards, and the valve is stopped by the tension of the valve spring.

2. Overhead Valve Mechanism

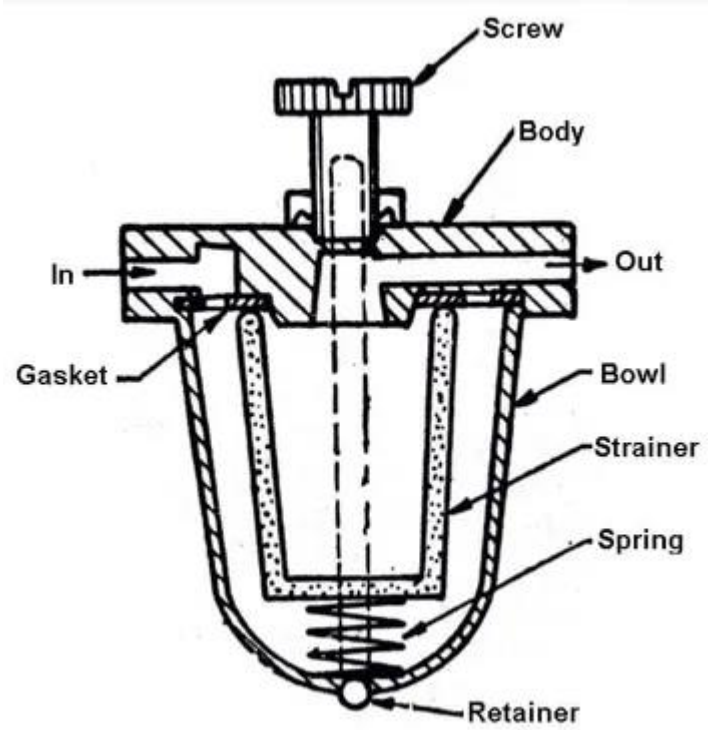
As the name says in this mechanism valves are placed overhead on the combustion chamber. As the camshaft turns, the cam lobe brings the tappet upward. When the tappet moves up, it pushes the pushrod and one end of the rocker

arm upwards. The other end of the rocker arm's tip moves downward, and the inlet valve opens against the spring's tension. When the cam lobe reaches the maximum height, the valve opens fully. Further rotation of camshaft causes the tappet to move down, and the valve is closed by the tension of the spring.

b) What is the function of Fuel Filters and explain any one Fuel Filters with neat sketch.

Fuel filters (primary & secondary) are provided to remove the impurities (water or dust) from the fuel while flowing from tank to reach fuel injection pump. Primary filter is usually made of wire mesh and used for removing the coarse particles. It is attached to the fuel feed pump.

Further to remove the fine particles and abrasive material in the fuel, secondary filter is used which is made of fine pores and it is placed after the fuel feed pump. These smallest impurities are retained to protect the extremely sensitive parts like fuel pump and injectors to get damaged. These filters are generally made of two sections/stages in which first stage is made of cloth and second is of paper through which the fuel passes to leave impurities behind in the fuel line.



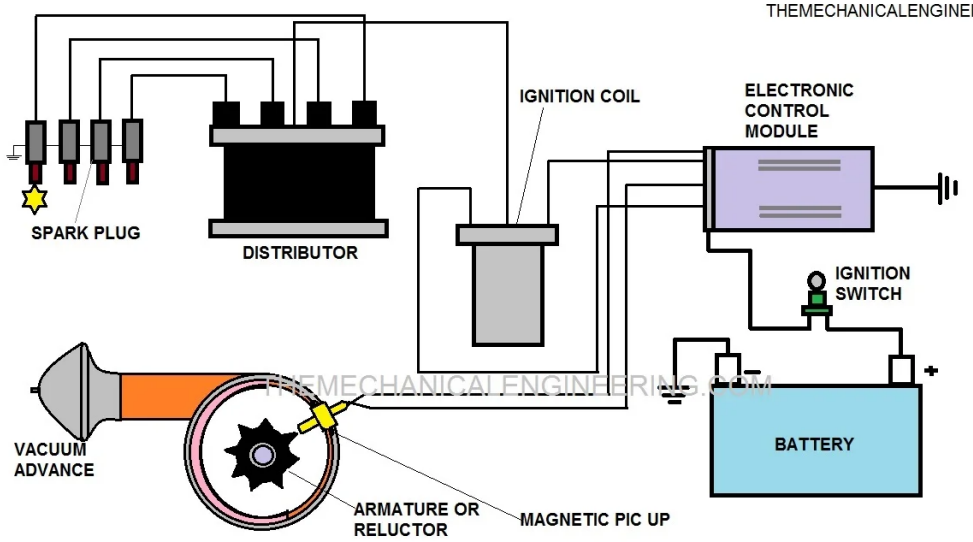
Fuel Filter Diagram

Unit -II

4 a) What are the Electronic Ignition and explain its merits and demerits.

Ans: Electronic Ignition System consists of following main Parts:

- Battery
- Ignition Switch
- Electronic control module
- Ignition coil
- Ignition distributor and
- Spark plug



ELECTRONIC IGNITION SYSTEM

Working: When the driver inserts the key into his car for switching on the ignition switch, just after that battery starts and it supplies current to the system.

Current passes through the ignition switch and move toward the ignition coil on the system then, start passing through the primary winding of the coil.
As the current passes through the primary coil, the pick-up coil got activated which is in the armature. It receives current as a voltage on the pick-up. Just after receiving voltage, the reluctor starts rotating which consists of the tooth. When the tooth comes in front of the pick-up coil exactly at the same time the pick-up coil starts sending a signal to the electronic control module.

After receiving a voltage signal, it stops the current supply from the battery up to the primary coil. When the tooth deviates from the point, it senses the change in voltage, and then again it sends a signal of change in voltage to the electronic control module.

We all know that the electronic control system is already a programmed system, so exactly after sending a signal of change in voltage it again starts supplying the current in the primary winding.

Because of this continuous make and break of the current circuit, it creates a magnetic field inside the ignition coil because of that, the secondary winding emf is induced.
Spark is generated because of the voltage difference between the central electrode and the ground electrode because the combustion is possible in air-fuel.

The following advantages of Electronic Ignition System includes:

- These are low maintenance systems as compared to others like Battery Ignition System, Glow plug ignition system, and Magneto Ignition System.
- It has no moving parts because it is controlled by the electronic control unit (ECV).
- Emission is less as compared to other means because this system is environmentally friendly.
- It increases the efficiency of the engine, and it is fuel-efficient.
- It is more accurate as compared to the magneto system.
- The vehicles having this system have a long life and reliable.

The main disadvantage of electronic Ignition is that this system is **very expensive** because all cannot afford the vehicles having an electronic ignition system.

b) Explain the function of Distributor type ignition system with a neat sketch

A distributor is defined as an enclosed rotating device that is used in I.C. engines with mechanically timed ignition.
The first reliable battery-powered ignition system was invented by a company named Delco. Then it was further developed by Charles Kettering and was considered a wonder in its time.

In the magneto system and many modern computer-controlled engines, the distributor has a mechanical or inductive breaker switch to open and close the primary circuit of the ignition coil.

The main function of the car distributor is to provide the high voltage current produced by the secondary coil to the correct spark plugs in the correct firing order and at the correct time. Now let's see what the parts are of a distributor.

Parts of Distributor

Following are the parts of a distributor:

- Cam
- Capacitor
- Condenser
- Contact breaker.
- Distributor cap
- Terminals
- Distributor shaft
- Drive Gear
- Rotor
- Spark advance mechanism

Function of Ignition Distributor:

The working of the ignition distributor is simple. When the distributor shaft began to rotate, it also rotates the cam and rotor of the distributor. While the cam rotates it pushes the cam follower that is connected to the contact breaker. The contact points of the contact breaker suddenly open and close the primary current through the primary winding. This action produces the high voltage of current in the secondary winding.

The high voltage current is transferred to the central terminal of the current distributor. This current from the central terminal then travels through the carbon brush to the outer edges of the rotor.

Finally, as the rotor makes contact with the internal terminal of the spark plug in the distributor cap, a high voltage electrical pulse travels to the spark plug and gives a spark within the cylinder head.

(OR)

5 a) Explain the splash lubrication system with a neat sketch.

It is employed for the engines of early motorcycles. One of the cheapest types of engine lubrication**.** It consists of a scoop at the end of big end bearing of connecting rod. It is placed such that when the piston reaches to bottom dead centre, the scoop submerges into the pan full of lubricating oil. When the piston moves from BDC, the scoop also rises but with some oil in it. As the connecting rod changes its direction when the piston reaches TDC, the scoop splashes the oil on to the cylinder walls.

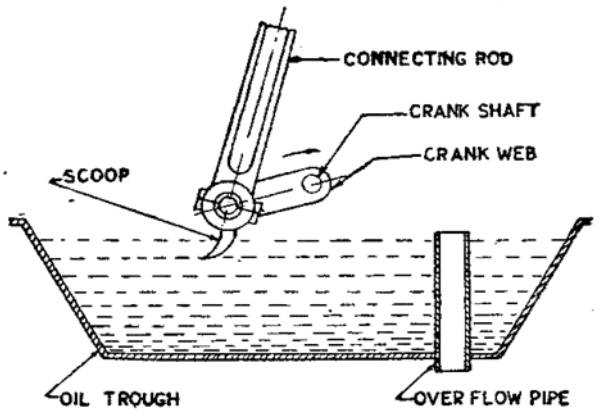


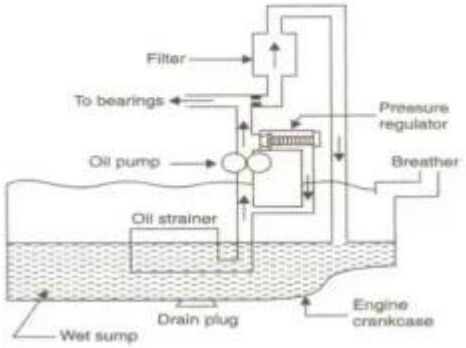
Fig. 6.7. Splash system lubrication.

b) Explain about Wet sump lubrication system with a neat sketch

Ans: The wet sump system is common and standard oil sump in an automobile engine. it's called wet sump because it contains oil in just the sump, serving as a reservoir and it uses a single oil pump. Oil circulating process seems to fast in this lubricating system because the oil is pumped from directly to the moving parts.

The sump is made of thin shaped stainless metal which is used to cover the engine beneath. It collects the oil when the engine is at rest. Wet sumps are shaped into deeper section, and it's mounted at the bottom of the crankcase serving as oil storage/reservoir. Though oil staving often occurs there are ways to prevent it.

Lubrication System – Wet Sump



Unit -III

6 a) Explain the construction and working principle of Sliding Mesh type gear box.

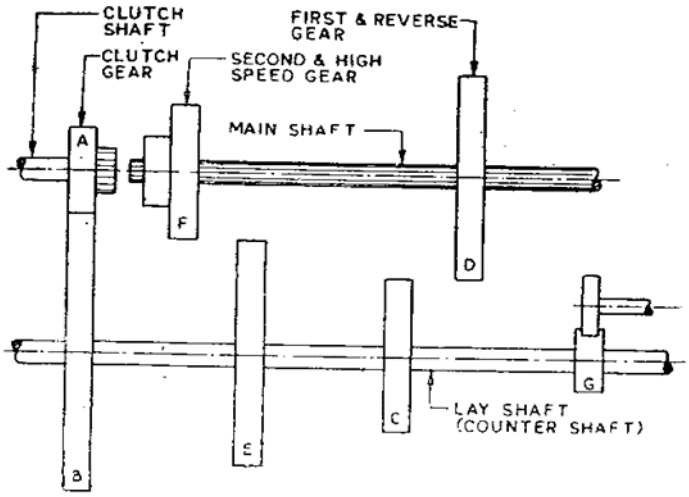


Fig. 4.6. Sliding Mesh Gear Box (gears in neutral).

- Mechanical efficiency is very low and the noise level quite high.
- Driver required considerable skill in changing the gears.
- The power comes from the engine to the clutch shaft and thence to the clutch gear which is always in mesh with a gear on the lay shaft.
- All the gears on the lay shaft are fixed to it and as such they are all the time rotating when the engine is running, and the clutch is engaged.
- Three direct and one reverse speed are attained on suitably moving the gear on the main shaft by means of selector mechanism.

b) What is the function of propeller shaft.

- This is the shaft which transmits the drive from the transmission to the bevel pinion or worm of final drive- in front engine, rear drive vehicles
- It is also called drive shaft. Consists of three parts

1. shaft: It is usually made of tubular cross-section. It also must be well balanced to avoid whirling at high speeds.
2. Universal Joints: this is account for the up and down movements of the rear axle when the vehicle is running
3. Slip joint: this serves to adjust the length of the propeller shaft when demanded by the rear axle movements.

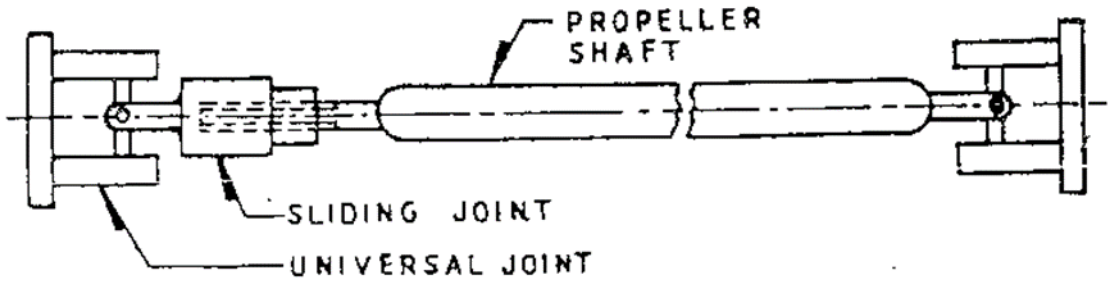


Fig. 6.1. Propeller Shaft.

- In vehicles with large wheelbase, the long propeller shaft would tend to sag and whirl
- whirl is like the action of a rope that is in an arc while held at both ends. At a certain speed the whirling becomes critical, and the shaft vibrates violently.
- Critical whirling speed of shaft can be increased by increasing its diameter, but that would increase its inertia which would decrease its acceleration and deceleration
- Critical whirling speed is also found to decrease as the square of its length. Thus, decreasing the length to half would increase the critical speed four times.

(OR)

7 a) Explain the elements of Suspension system.

1. Springs, which neutralize shocks from the road surface (energy storage)
2. Shock absorbers, which act to improve comfort by limiting the free oscillation of the springs. (Power dissipation)
3. Stabilizer (stabilizer bar or stabilizer bar), which prevents the side swaying of the car.
4. An articulation system, which acts to hold the previous components in place and control the longitudinal and lateral movements of the wheels.

b) What is the need of suspension systems in an automobile.

Need for suspension system:

1. To absorb shocks and vibrations caused by irregularities in the road.
2. To transmit the load of the vehicle to the wheels (bearing the weight)
3. To maintain the stability of the vehicle (contact of the wheels with the ground)
4. To provide cushioning and ride comfort to passengers
5. To prevent body squat and body dip

Unit -IV

8 a) Find Explain brake actuation mechanisms mechanism with a neat sketch.

Ans: Brake is used to stop or slow down the motion of an automobile. It is mounted on the driving axle and operated by two independent pedals. Each pedal can be operated independently to assist the turning of tractor during the fieldwork or locked together by means of a lock.

Principle of operation: Brake works on the principle of friction. When a moving clement is brought into contact with a stationary element, the motion of the moving element is affected.

This is due to frictional force, which acts in opposite direction of the motion and converts the kinetic energy into heat energy.

Brake Actuation Mechanisms:

(a) Foot brake (also called service brake) operated by foot pedal.

(b) Hand brake – it is also called parking brake operated by hand.

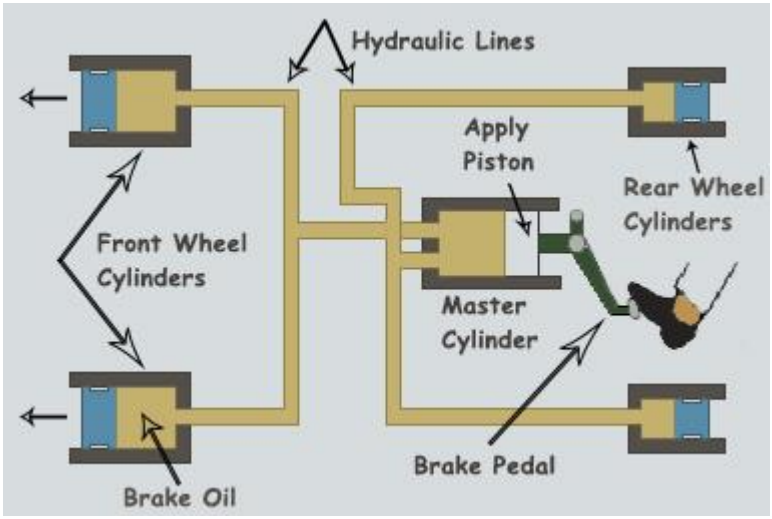
In road vehicles, the **parking brake**, also called **hand brake**, **emergency brake**, or **e-brake**, is used to keep the vehicle stationary and in many cases also perform an emergency stop. Parking brakes on older vehicles often consist of a cable connected to two-wheel brakes at one end and the other end to a pulling mechanism which is operated with the driver's hand or foot. The mechanism may be a hand-operated lever, at floor level beside the driver, or a straight pull handle located near the steering column, or a (foot-operated) pedal located beside the driver’s leg. In most automobiles the parking brake operates only on the rear wheels, which have reduced traction while braking. Some automobiles have the parking brake operate on the front wheels.

The most common use for a parking brake is to keep a vehicle motionless when it is parked. The park brake has a ratchet or other locking mechanism that will keep it engaged until manually released. On vehicles with automatic transmissions, this is usually used in concert with a parking pawl in the transmission.

b) Explain the working principle of Hydraulic braking system with a neat sketch

Ans: A hydraulic brakes system is a braking mechanism that uses brake fluid to transmit force into the system. The fluid transfers pressure from the control mechanism to the braking mechanism. In this type of braking system, the mechanical forces transmitted by the driver on the brake pedal are converted to hydraulic pressure by a device known as a master cylinder, and then this hydraulic pressure is sent to the final drum or disc. It goes to stop or accelerate the calliper vehicle.

The hydraulic brakes are a type of braking system widely used in automobiles with the application of hydraulic fluid. The working principle of hydraulic braking systems is based entirely on Pascal's law, which states that the intensity of pressure inside a system closed by a liquid is always the same in all directions.



The working of the hydraulic braking system is very simple. To execute the brakes, we have two types of components: a disc brake and a drum brake. The initial work is the same for both types, but the execution technique is different. Disc brakes are externally applied brakes through the brake calipers and discs, while drum brakes are applied internally through brake shoes and brake drums.

(OR)

9 a) What are the advantages and disadvantages of using electrical vehicles.

<u>Advantages of Electric Vehicles</u>

1. Eco-friendly: Because electric vehicles do not utilize fuel for combustion, there are no emissions or gas exhaust. Vehicles that run on fossil fuels contribute significantly to hazardous gas accumulation in the environment, thus driving an electric car can help contribute to a cleaner environment.

2. Renewable energy source: Electric vehicles run on renewable power, whereas conventional automobiles function on the combustion of fossil fuels, which reduces the world's fossil-fuel stocks.

3. Less noise and smoother motion: Driving an electric car is significantly smoother. Because they lack fast-moving elements, they are quieter and produce less noise.

4. Cost-effective: Electricity is far less expensive than fuels such as gasoline and diesel, which are subject to regular price increases. When solar electricity is utilized at home, battery recharging is cost-effective.

5. Low maintenance: Because electric cars have fewer moving components, wear and tear is reduced when compared to traditional auto parts. Repairs are also simpler and less expensive than combustion engines.

6. Government support: Governments throughout the world have granted tax breaks to encourage people to drive electric vehicles as part of a green program.

Disadvantages of Electric Vehicles

1. High initial cost: Electric vehicles continue to be quite expensive, and many buyers believe they are not as inexpensive as traditional automobiles.

2. Charging station limitations: People who need to travel long distances are concerned about finding adequate charging stations in the middle of their journey, which are not always accessible.

3. Recharging takes time: Unlike conventional automobiles, which require only a few minutes to replenish their gas tanks, charging an electric vehicle takes many hours.

4. Limited options: Currently, there aren't many electric car models to pick from in terms of appearance, style, or customized variations.

5. Less driving range: When compared to conventional automobiles, electric vehicles have a shorter driving range. Electric cars can be convenient for short-distance travel but are inconvenient for long-distance travel.

b) Illustrate the hybrid vehicle layout and list out its advantages and disadvantages

Basically, a hybrid car is one that uses two or more engines, i.e., an electric motor and a conventional engine (either petrol or diesel).

Types of Hybrid Electric Vehicles

There are three types of HEVs based on power delivery and distribution. Below are more details on the same.

1. Series hybrid

In a series hybrid system, the IC engine powers the electric generator, which drives the electric motor and charges the battery. In this setup, the engine does not directly power the wheels. Series hybrid is also called a range extender since the engine powers the electric motor and the battery pack.

2. Parallel hybrid

In this system, both the engine and electric motor work parallel to propel the vehicle. The engine and the electric motor deliver optimum power for the efficient functioning of the car. The battery pack gets charged via regenerative braking. If you wonder what regenerative braking is, here's a brief explanation. Regenerative braking is a process of utilising the kinetic energy produced while slowing the vehicle down to charge the battery pack.

3. Series-parallel hybrid

A series-parallel is a flexible system wherein the IC engine, and electric motor can work in conjunction or independently. The power delivery or the power distribution helps the vehicle achieve maximum efficiency in terms of power output or fuel-efficiency.

Advantages of a Hybrid Car

1. Environmentally Friendly
2. Financial Benefits
3. Less Dependence on Fossil Fuels
4. Regenerative Braking System
5. Built from Light Materials
6. Assistance from Electric Motor
7. Smaller Engines
8. Automatic Start and Stop
9. Electric-Only Drive
10. Higher Resale Value

Disadvantages of a Hybrid Car

There are disadvantages to owning a hybrid car, but they are probably not what you think. Contrary to the popular myth, hybrid cars have just as much power as regular cars and have no issues with mountain driving or towing. The disadvantages will depend on the type of hybrid fuel that your vehicle uses.

1. Less Power
2. Can be Expensive.
3. Poorer Handling
4. Higher Maintenance Costs
5. Accident from High Voltage in Batteries

6. Battery Replacement is Pricey
7. Battery Disposal and Recycling
8. Hydrogen Fuel Cell Issues

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