

SIXTH SEMESTER DIPLOMA EXAMINATION IN MECHANICAL ENGINEERING—MARCH,2014

AUTOMOBILE ENGINEERING

(Maximum marks : 100) [Time : 3 hours]

PART—A (Maximum marks : 10)

I. Answer all questions in one or two sentences. Each question carries two marks.

1. Define carburation.

Ans: The process of preparing the charge for SI engines is called carburation. Charge means atomizing the fuel and mixing of fuel with air at required proportion.

2. List any two functions of gear box.**Ans:**

- To exchange the engine power for greater torque and provide mechanical advantage to drive the vehicle under different operating condition.
- To provide reverse motion.

3. What is the purpose of bleeding in automobile braking.

Ans: Sometimes, in the hydraulic brake system, air enters through the joints. Since the air is compressible, high braking pressure is disturbed and pedaling action is not effective. So, any air trapped in the system must be removed the procedure adopted to remove the air out of the braking system is called Bleeding.

4. What are the pollutants contained in automobile emission.

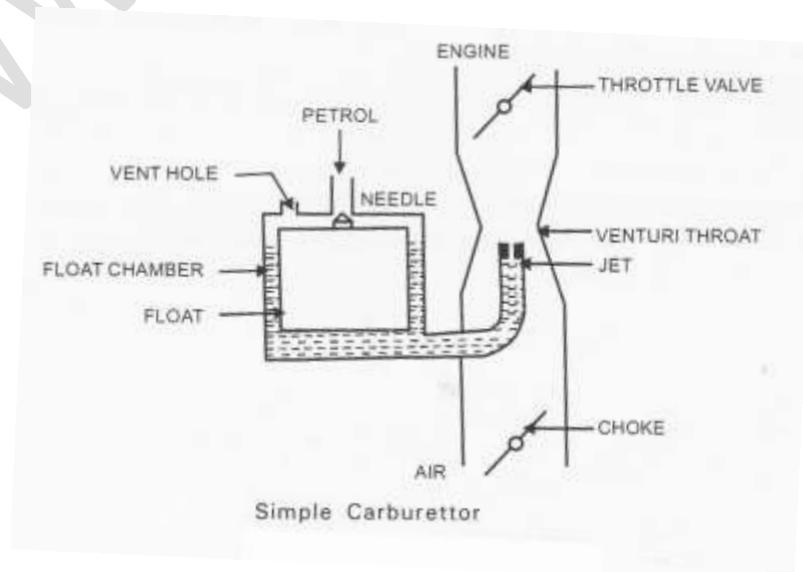
Ans: Hydrocarbons, Nitrogen oxide, Carbon monoxide, carbon dioxide.

5. What do you mean by power steering.

Ans: The main objective of power steering is to reduce the driver's effort in steering. The system may employ electrical devices, pneumatic and hydraulic pressure.

PART—B (Maximum marks : 30)

II. Answer Any five questions. Each question carries 6 marks.

1. Explain the principle of a simple carburetor with a sketch.**Ans:**

During suction stroke, a partial vacuum is created in the engine cylinder and carburetor. Due to this, air flows into the carburetor. At the narrow section of the venturi tube velocity of air increases and air pressure is correspondingly reduced. A pressure difference is thus produced between float chamber and then venturi, which causes the fuel to flow out of fuel jet in the form of spray. The fuel delivered by the jet into the air stream is finally atomised, mixed with air and vaporised to form homogeneous air fuel mixture which is admitted to the engine cylinder.

2. What are the pollution control techniques in SI engines.

Ans: Engine efficiency has been steadily improved with improved engine design, more precise ignition timing and electronic ignition, more precise fuel metering, and computerized engine management.

Advances in engine and vehicle technology continually reduce the toxicity of exhaust leaving the engine, but these alone have generally been proved insufficient to meet emissions goals. Therefore, technologies to detoxify the exhaust are an essential part of emissions control.

Air injection

One of the first-developed exhaust emission control systems is secondary air injection. Originally, this system was used to inject air into the engine's exhaust ports to provide oxygen so unburned and partially burned hydrocarbons in the exhaust would finish burning. Air injection is now used to support the catalytic converter's oxidation reaction, and to reduce emissions when an engine is started from cold. After a cold start, an engine needs an air-fuel mixture richer than what it needs at operating temperature, and the catalytic converter does not function efficiently until it has reached its own operating temperature. The air injected upstream of the converter supports combustion in the exhaust headpipe, which speeds catalyst warmup and reduces the amount of unburned hydrocarbon emitted from the tailpipe.

Exhaust gas recirculation

In the United States and Canada, many engines in 1973 and newer vehicles (1972 and newer in California) have a system that routes a metered amount of exhaust into the intake tract under particular operating conditions. Exhaust neither burns nor supports combustion, so it dilutes the air/fuel charge to reduce peak combustion chamber temperatures. This, in turn, reduces the formation of NO_x.

Catalytic converter

The catalytic converter is a device placed in the exhaust pipe, which converts hydrocarbons, carbon monoxide, and NO_x into less harmful gases by using a combination of platinum, palladium and rhodium as catalysts.

There are two types of catalytic converter, a two-way and a three-way converter. Two-way converters were common until the 1980s, when three-way converters replaced them on most automobile engines. See the catalytic converter article for further details.

3. List the requirements of good clutch.

Ans:

- Gradual engagement.
- Torque transmission.
- Heat dissipation.
- Vibration damping.
- Dynamic balancing.
- Free pedal play.
- Ease of operation.

4. Differentiate between torque converter and fluid coupling.

Ans:

Fluid coupling	Torque converter
1) Contains only two members impeller and turbine.	1) Three members impeller, turbine and a stator.
2) Simply a torque transmission unit.	2) Torque multiplication unit 3:1 to 4:1.
3) Serves as an automatic clutch.	3) Serves as an automatic clutch as well as a torque multiplier.
4) Efficient at high speeds.	4) Inefficient at high speeds but more efficient under load.
5) Impeller and runner are locked up and oil movement stops when centrifugal force is the same on both the member.	5) No such locking and oil flows continuously.

5. List advantages of independent suspension system (any six only).

Ans:

- The elastic strain energy per unit spring weight stored in a coil or torsion bar spring is greater than in case of a semi-elliptic leaf spring.
 - In case of independent suspension, unsprung weight is reduced.
 - Compared to the rigid axle type, softer springs can be used without increasing rolling effect. Soft springs improve ride comfort.
 - Improved steering precision since wheel movements are not linked. Gyroscopic action is reduced and the wheel travel path is controlled more accurately.
 - In case of independent suspension it is possible to locate the springs apart enough to obtain understeer condition.
 - With independent suspension, steering geometry is not altered with spring deflection as in case of conventional rigid axle suspension where effect is especially noticeable during braking or acceleration.
6. **Distinguish between tubed and tubeless tyres.**

Ans: Tyres play a big role in the way a car handles itself. It not only affects the vehicle's mileage but safety as well. Essentially, when it comes to tyres, there are two types – Tube and Tubeless. Let's tell you in a bit more detail what to expect from these difference options.

As the name suggests, a tube tyre consists of a tube of air that is placed inside the tyre. The air acts as a cushion and makes driving over bumpy roads a bit smoother. It also maintains the shape of the tyre and most importantly supports the weight of the vehicle, keeping it stable.

On the other hand, a tubeless tyre weighs less and reduces un-sprung weight of the vehicle. This gives you superior handling characteristics and inspires confidence in the driver. The overall result – a better driving experience!

However, the advantages of driving on a set of tubeless tyres far outweigh tubes. This is especially visible when a tyre gets punctured. With a sudden loss of air pressure, your car can get unstable and swerve, eventually leading to an accident. In similar condition, a tubeless tyre would lose its air slowly and uniformly, thus giving the driver ample time to slow the vehicle down.

Other advantages also lie in tubeless tyres like; its resistance when driving is much lower, the car feels lighter and has less friction, making it more economical. Apart from that, it has lesser components, generates low heat while on the move and causes minimal vibration. One of the most important difference is that they last longer than tubes.

7. **Distinguish between leading and trailing brakes.**

Ans: **Leading shoe:** In this case, the shoe tip is dragged along the drums and produces more force against the brake drum. So an equal braking effect is produced.

Trailing shoe: This end to move away from the drum during braking. This is opposing the rotation of the drum.

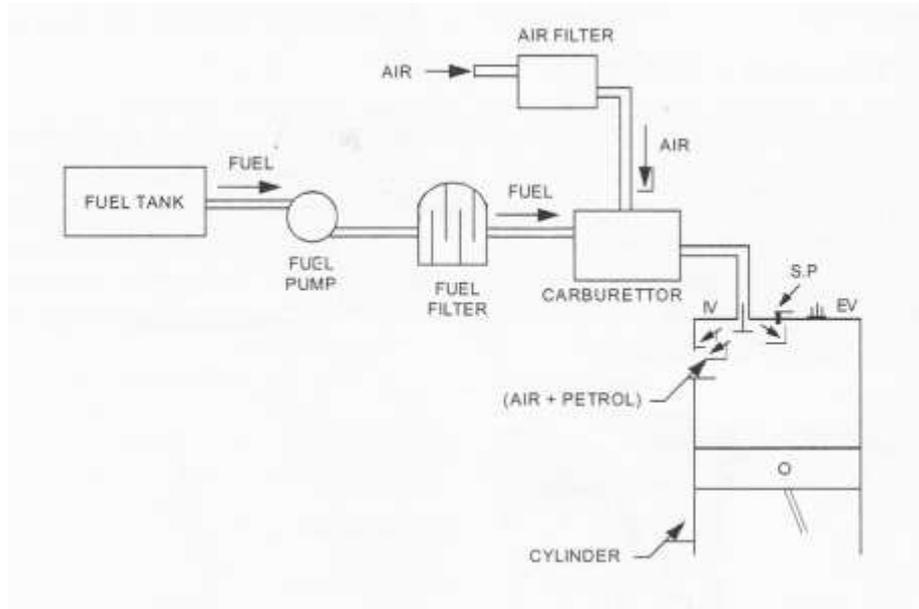
PART—C (Maximum marks : 60)

Answer one full question from each unit . Each question carries 15marks.

UNIT – I

III. (a) Draw the layout of fuel system of a diesel engine and briefly explain its working.

Ans:



The main components of fuel injection system are, Fuel tank, Fuel feed pump, Filter, Injection pump, and Injector.

During the operation, the fuel from the tank enters the fuel feed pump. In feed pump the pressure of fuel is raised slightly. Then the fuel is drawn into the filter where all the dust particles are removed. From the filter the fuel enters into the injection pump where the pressure of fuel is increased above the pressure of air in the cylinder at the end of compression. At this high pressure fuel is sprayed into the engine cylinder by means of fuel injector. Any spill over fuel in the injector is returned to the filter.

(b) List any seven properties of lubricants.

Ans: Properties of Lubricants:

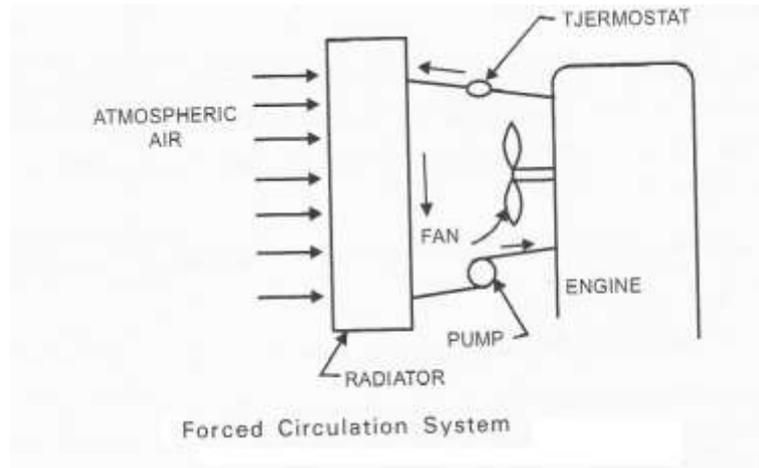
- (1) Viscosity
- (2) Flash Point
- (3) Cloud point and pour point
- (4) Aniline point
- (5) Corrosion resistance.
- (6) physical stability.
- (7) Fire Point

OR

IV. (a) Explain forced water cooling system with a neat sketch.

Ans: In this system water circulation is maintained by a pump operated by the engine itself. Cooling water enters at lower position of the engine and absorb heat while it is passing through jacket. The hot water come out from the top and passes in to the radiator where it is cooled and then return to the jacket. Cooling of water in radiator is effected by atmosferic air drawn through the radiator by fan.

In modern cooling system a thermostat is used. It controls the jacket water temperature. When the water temperature is low, thermostt closes the valve and water circulation is cutoff. When the temperature of water in jacket reached to a suitable valve for efficient operation, thermostat opens the valve and circulation of water is maintained by the pump.



In this system the cooling is effective under all conditions of operation. But cooling is stopped as soon as the engine is stopped. This system is used for cooling large and medium size engines.

(b) What are the effects of vehicle noise in human being.

Ans: Due to heavy industrialization, exposure of high level of noise gives rise to stress factor in modern life. It many leads to many hazards. The effect of noise on health depends on both, loudness and frequency. Any source producing sound levels of more than 80 to 90 db for more than eight hours is harmful to human ear.

i. Psychological effect:

Noise leads to emotional disturbances, however, are difficult to measure. Irritating noise at work place reduces concentration efficiency and working capacity.

ii. Masking effect:

Masking noise prevents the ear from registering other important sounds and signals. These effects change the balance in predator/prey detection, by disturbing and interfering the sounds of communications especially during reproduction time period and loss of hearing.

iii. Physiological effect:

a) Auditory

- Auditory fatigue (When level of noise ranges from 85-90db)
- Defness (repeated exposure to noise level > 90 db)

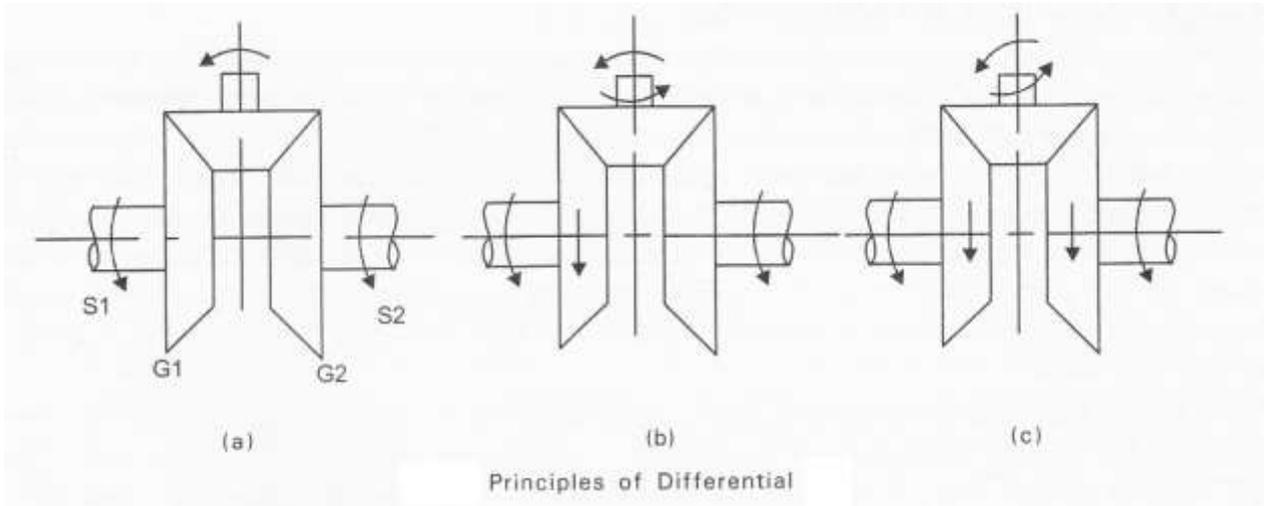
b) Non auditory

- Annoyance (listens dislike the noise content)
- Efficiency (noise pollution decreases efficiency of working)
- General changes in body (high blood pressure, fatigue, hypertension, tetanus)

UNIT – II

V. (a) With a neat sketch explain the working principle of a differential.

Ans:

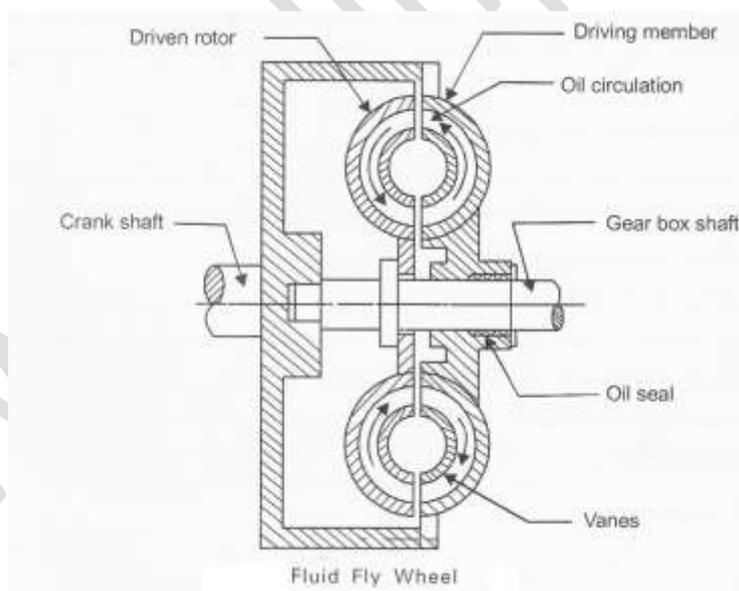


The figure explain the functioning of differential. When the shaft is moved in a stright ahead position, the bevel gears along with the shaft shall revolve at the same speed in the same direction, irrespective of the speed of the shall. If s-2, is held, stationary, then the right side bevel gear will nut rotate. In this case , if the main shaft is assumed to move forward, the pinion rotates about its own axis and the left side bevel gear rotates faster, then in the previous case. Because in this case the left side bevel gear recieves two different motions due to,

- 1) Forward pulling of the shaft as before.
- 2) Rotation of the pinion about its own axis which is in constant mesh with the bevel gear.

Suppose the right side bevel is allowed to slip on pinion wheel, then the left side bevel gear shall rotate at a lower speed than in the previous case.

(b) Describe the working of a fluid coupling.



This is a liquid coupling used to transmit the engine turning force to a clutch. This assembly consists mainly two members.

- a) Driving member. And
- b) Driven member.

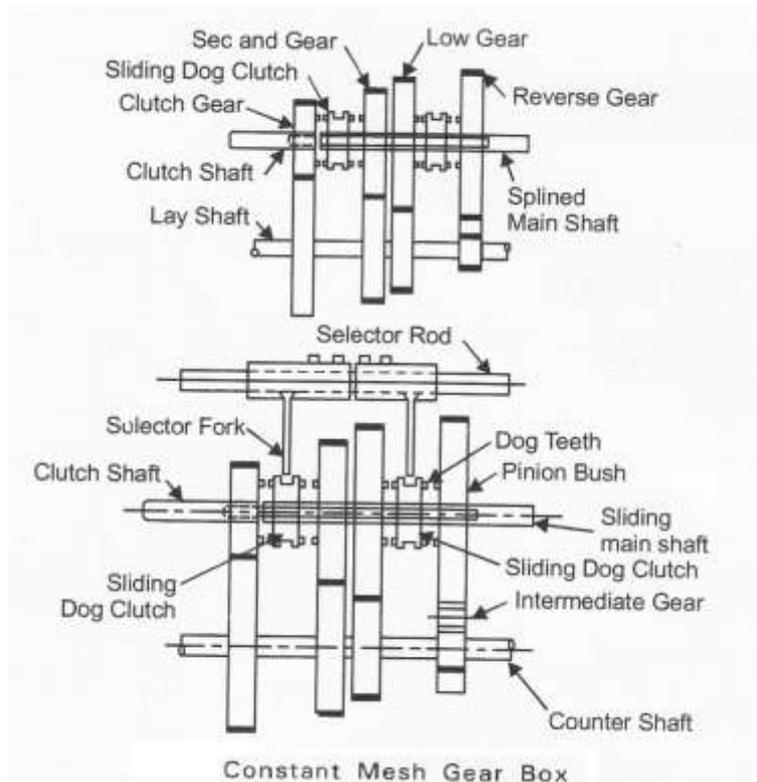
When the engine is started, the oil from the driving member is forced outward radially because of the centrifugal force. The oil moves generally in two directions at the same time. A rotary flow at right angles to the shaft and also in a vortex flow because of circulation between the impeller and the runner. The rotary flow initiates the movement of the runner. The vortex flow is at right angles to the rotary flow.

The oil is thrown out against the curved interior surface because of centrifugal force. Then, it is directed across, to the runner and returned to the impeller. When the efficiency of the coupling is highest, under best operating conditions, runner speed almost equal to the impeller. The lagging of the driven unit behind the driving unit is known as slip.

OR

VI. (a) Explain the working principle of a constant mesh gear box with a suitable sketch.

Ans: Figure shows the simple arrangement of the constant mesh gear box. It has three shafts namely primary shaft, main shaft and lay shaft. The clutch shaft gear is in mesh with the biggest gear of the counter shaft and the other gears of the counter shaft are also in constant mesh with the corresponding gears on the main shaft. The gears on the counter shaft rotate along with the shaft but the main shaft gears are free rotate bushes. The main shaft is splined shaft. Dog clutches are provided which are free to slide on the main shaft. Selector forks are also provided to move the dog clutches to engage with the other set of dog clutches. The gear blanks are also provided with dog teeth on their faces. The power flow is the same as in the sliding mesh gear box.



When the second dog clutch is slide to the right side, it engages the larger gear on the main shaft to the smallest on the counter shaft, to rotate as a single unit. So, now the power flow is through the clutch shaft to the largest gear on the lay shaft and then through the above unit it comes out from the splines to the main shaft.

Similarly when the second dog clutch is slide to the left and gets engaged, second gear is obtained.

When the first dog clutch is slide towards left, the clutch directly engages with the clutch shaft, and power is directly transmitted as in sliding mesh gear box.

(b) Explain the working of a transmission system in automobile with a layout.

Ans:

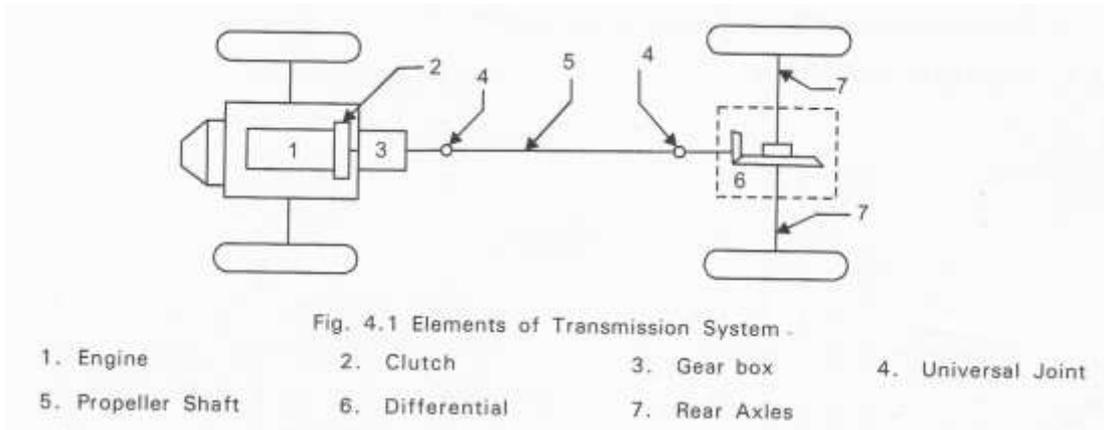
1. Clutch:

- To connect the fast running engine to the stationary transmission in a progressive manner to effect smooth take off from rest.
- To engage or disengage the engine from transmission.

2. Gear Box:

- To change the speed of the vehicle.
- To reverse the vehicle.

To overcome the low torque at low speed.



3. Propeller shaft:

- To transmit power from the gear box to the differential and at last to the final drive.
- To enable the driving wheels to move back and forth due to fixing of road springs.

4. Universal joint:

- To enable the drive shaft to transmit power at different angle.

5. Differential:

- To bring down the speed of propeller shaft to that of the road wheels.
- To provide different rotational speeds to the road wheels when the vehicle negotiates curved paths.

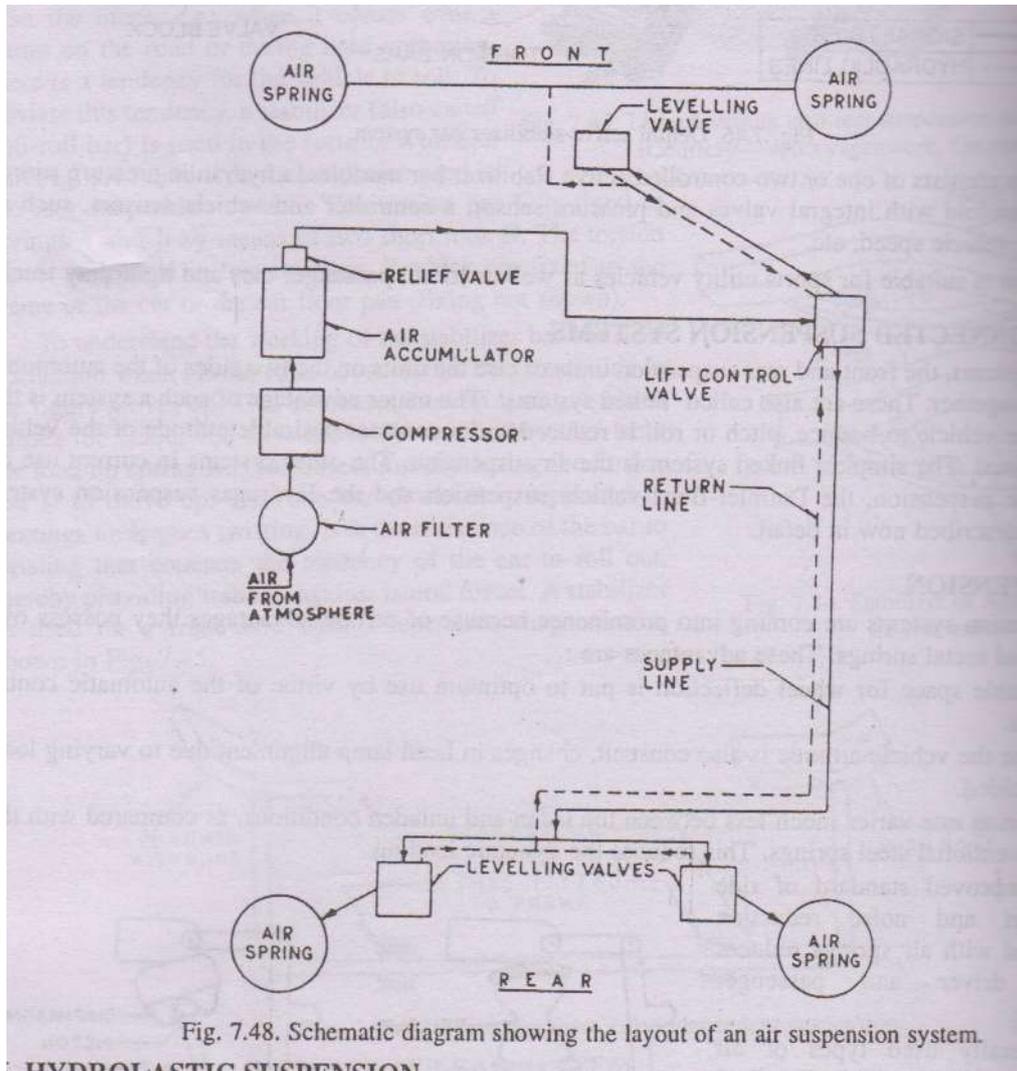
6. Rear axle:

- To rotate the two rear wheels.

UNIT – III

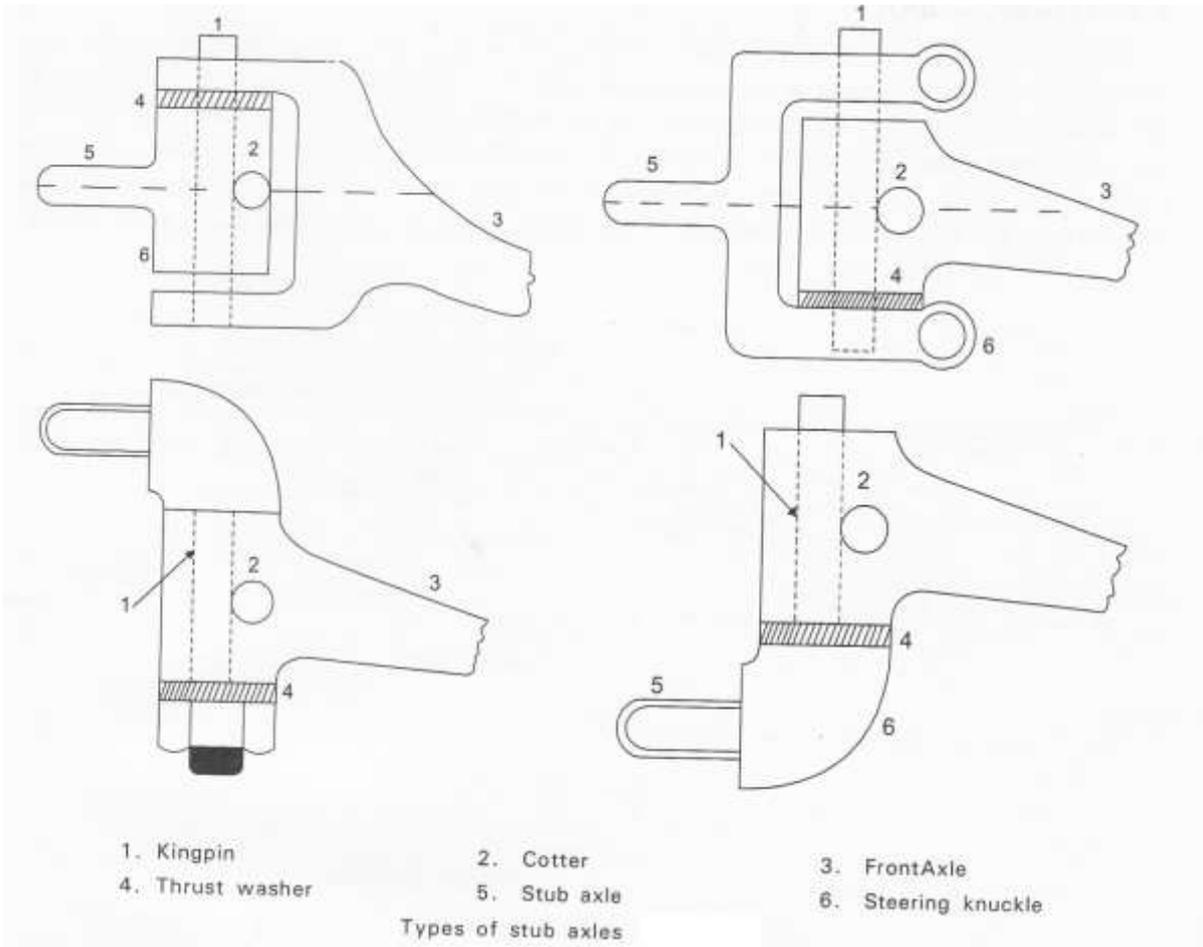
VII. (a) Explain air suspension system with a diagram.(vol01-192)

Ans:



The layout of an air suspension system as shown in figure. The for air springs, which may be either the bellows type or the piston type as discussed above, are mounted on the same position are generally the coil springs are mounted. An air compressor takes the atmospheric air through a filter and compresses it to a pressure of about 240Mpa, at which pressure the air in the accumulator tank is maintained, which is also provided with a safety relief valve. This high pressure air goes through the life control valve and the levelling valves, to the air springs as shown. The lift control valve is operated manually by means of a handle on the control panel, through a cable running from the valve to the handle.

(b) Sketch four types of stub axles.

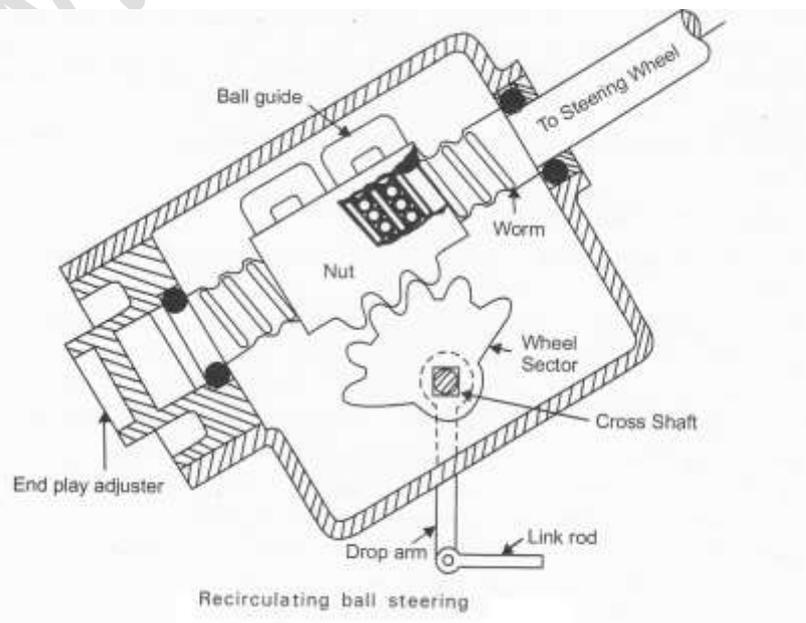


OR

VIII. (a) Describe recirculating ball type steering gear with figure.

Ans: A recirculating ball gear has a driving gear and a driven gear. The driving gear is a worm gear with spiral threads. The driven gear is a sector gear, connected to the pitman arm.

This is a screw and nut type of steering gear box. The lowest end of the steering shaft carries a screw and a screw nut. The outer surface of the nut is provided with a threaded portion engaged with the sector wheel. The sector wheel is connected to the drop arm through cross shaft. The inner threads of the nut and the thread form of the screw are shaped as semi-circular grooves or a recirculating ball race is provided between the nut and the screw.



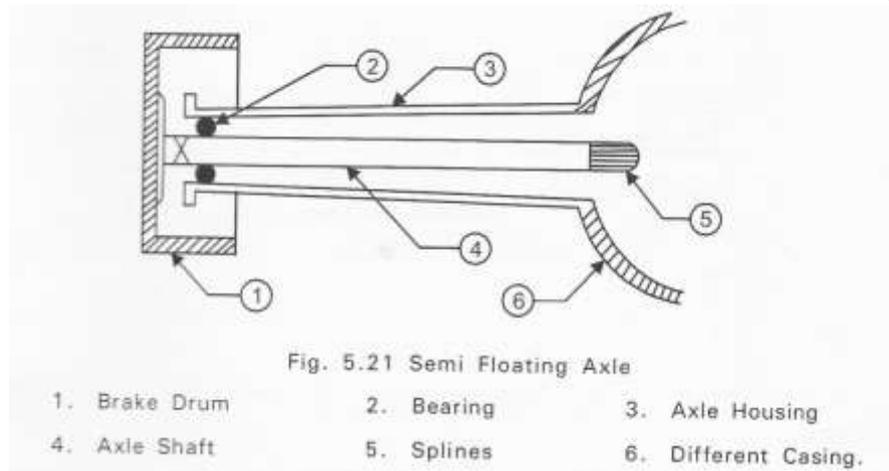
By turning the steering wheel, the balls in the worm, roll along the grooves. This movement causes the nut to travel along the worm. The balls are recirculated through the return guides shown. The up and down movement of the ball nut causes the wheel sector to turn to the required angle. The wheel sector actuates the drop arm and thereby the link rod. This results in the steering of the front wheels.

(b) List the types of rear axles and explain about one of them with a sketch.

Ans: Rear axle shafts are of three general types, classified according to the manner in which they are supported. They are as follows,

1. Semi floating axle.
2. Three-Quarter floating axle.
3. Full floating axle.

Semi floating axle:

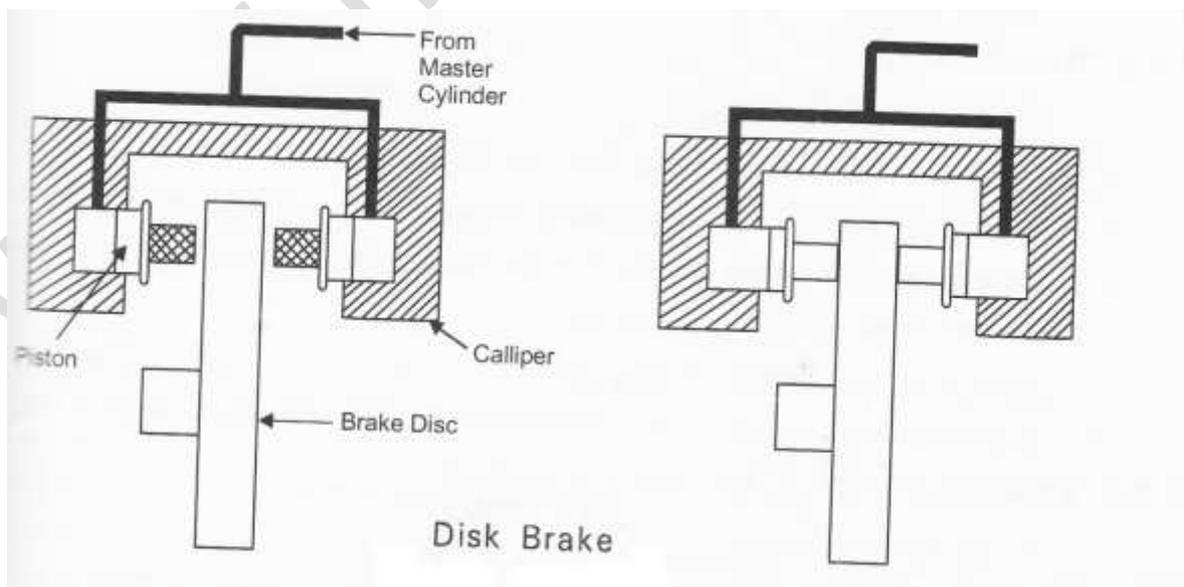


It is splined on the differential end and uses this end for driving purpose only. This end floats and carries no weight. A bearing is placed between the axle shaft and the housing at the outer end to carry the weight of the vehicle. The shaft is held in position by a lock on the differential end or by a bearing on the outer end.

UNIT – IV

IX. (a) With a suitable sketch explain the functioning of a disc brake.

Ans:



The disc type used in automobile is normally of a caliper type, consisting of a rotating disc and two friction pads on either side. The road wheel is connected to the outer surface of the disc with a splash shield providing protection for the inner

surface. While fitting the disc brake in the front wheel, the caliper assembly is secured to the steering knuckle. In the case of the rear wheel brake, it is connected to the axle housing.

The disc is made of high grade gray cast iron with better wear resistance property. And superfinishing. The friction pads made up of asbestos, fibre are fixed to a steel backing plate. This backing plate provided to take torque reaction during braking. The friction pads are held in radial position on the backplate by two retaining pins passing through the holes in calipers. The friction pads ride freely on either side of the disc and are positioned by the hydraulic pistons. The two wheel cylinders in the caliper half is connected by the drilled passages to the hydraulic brake line. The hydraulic fluid fed in the line completely. The size of the piston is made equal to that of the pads to reduce noise during braking. Rubber seals are provided for dust and moisture protection.

(b) Distinguish bias (cross) ply and radial ply tyres.

Ans: Radial ply tyre:

Here ply cords run in radial direction or in the direction of the tyre axis. There are some breaker strips in the circumferential direction. The material used for breaker strips is flexible, so that there is no change in circumference due to variation of inflation. These breaker strips which are in-extensible, function like girders and provides directional stability.

Bias ply tyre:

In this type, the ply cords are woven at an angle (30° - 40°) to the tyre axis. There are two layers which run in opposite directions as has been shown in the figure. However, the cords are not woven like warp and weft of ordinary cloth, because that would lead to rubbing of the two layers and thus produce heat which would damage the tyre material.

OR

X. (a) Explain the working of common rail fuel injection system with a sketch.

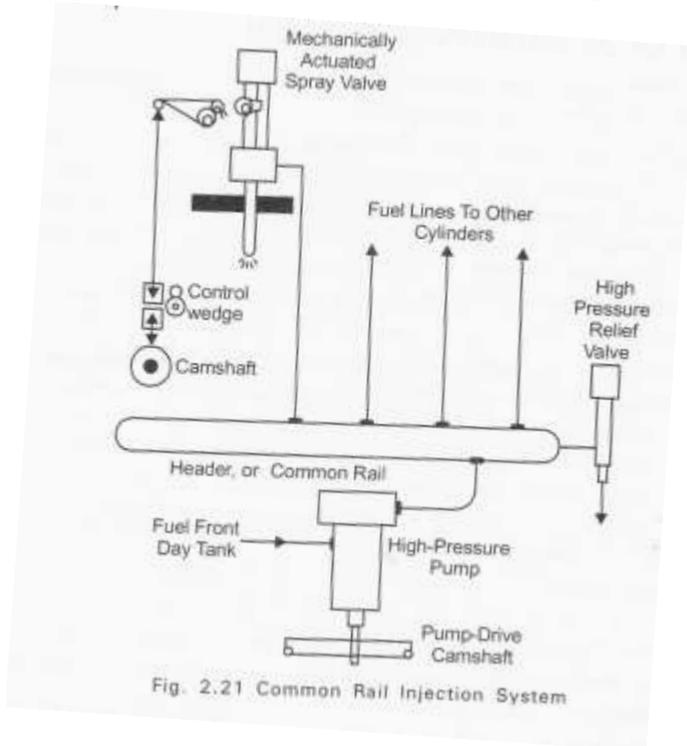
Ans: Common rail diesel injection system

Common rail direct injection (CRDI) is an advanced fuel injection system that uses a common rail or tube to inject pressurized fuel directly into the car engine whilst maintaining constant high pressure. The pressure in the engine ensure that the fuel breaks into small particles during injection and evenly mixes with the air, eventually reducing automotive pollution. When the air and fuel is evenly mixed, the amount of unburnt fuel is reduced that further reduces the amount of harmful emissions from the vehicle.

Working:

In common rail engine system, the high pressure fuel pump stores a reservoir of fuel at a pressure of at about 29,000 psi in a common rail. This common rail is actually a tube which branches off to computer controlled fuel injector valves that comprise a precision-machined nozzle and a plunger driven by a solenoid valve. The fuel reservoir then pumps out the fuel to multiple injectors that are electronically controlled by the engine control unit. Under the control of an on-board computer, the engine regulates the fuel quantity and pressure. It also controls the precise moment when the actual process of fuel injection occurs and also increased the pressure at which fuel is injected. This in turn results in better fuel atomization and combustion, eventually

leading to lower exhaust emissions, lower fuel consumption, and increased fuel efficiency.



(b) Write notes on centre locking system.

Ans: The central locking system is controlled by an electric device called the central locking control unit that is basically a relay. There are normally 4 wires that go to each door. Two of the wires connect to the lock mechanism and tell the central locking control unit whether the doors are locked or not. The other two wires connect to the actuator which can either take the form of a motor or an electro magnet. The central locking control unit connects these wires in one direction to lock and the opposite direction to unlock the doors. Most modern cars also have a remote key fob. This send a radio or IR signal to a detector which then connects to the central locking control unit to tell the car to lock or unlock. This uses a coded signal that is unique to that particular key fob.