Rajasthan Institute of Engineering & Technology, Jaipur

III Year B. Tech V Semester I Mid Term Examination, September – 2018

 Branch: - Mechanical Engineering Solution SET-A

 Subject: - Automobile Engg. (5ME6.2A) Section: ALL

Q1. Whether you are building a car from scratch or are simply interested in the bodywork of a car, recognizing different types of car chassis can prove beneficial. This can also be of assistance in helping you to choose the correct type for the car.

1 – Ladder

A ladder frame car chassis is a common type of frame used as a base for vehicles, creating a solid base from the shape that the name suggests.

2 – Backbone

A substantial central component is necessary for a backbone car chassis, connecting the front and rear of the entire frame.

3 – Monocoque

A monocoque car chassis is one that uses metal that is molded from sheets of the material, which is the same method used to build other parts of the frame. This type of chassis is similar to a unibody type.

4 – Space

A space chassis can also be known as tubular even though it is not tubular in the true sense. The components are welded together to create a strong frame that comprises some flexibility.

5 – Combination

You will often find that a car chassis is not any single types, taking elements from a range of different types to create a version that is best suited to the car frame.

OR

**Chassis And It’s Components In Automobile System**

A **chassis** is a physical frame or structure of an automobile, an airplane, a personal computer, or any other multi-component device.

**Components of the chassis**

The various components and their location in a vehicle are:

**Engine** yields power needed to move the vehicle at the desired speed, overcoming the external resistances. This could be a SI engine or CI engine or gas engine.

**Radiator** is a device that is used to re-cool the hot engine cooling water for recirculation purpose. The radiator is connected by rubber hoses to the engine, to permit the cooling system water to circulate between them.

**Clutch** isolates the engine from the transmission system as when needed. It also allows the vehicle to be started from rest, smoothly and with jerks.

**Gearbox**helps the torque of the needed amount at the driving road wheels. Whenever the resistance to be overcome by the vehicle changes, the gear ratio is to be changed. The gear box serves precisely the purpose. The gearbox also helps to reverse the vehicle.

**Universal joints** cum propeller shaft transmit the torque from the gearbox shaft to the final drive. The gearbox is generally attached to the vehicle frame. The final drive, differential and rear axle are connected to the frame by means of springs. As the tyres of the vehicle hit bumpers on road, the rear axle moves up and down. The universal joints help the propeller shaft to attain different inclination.

**Final drive** transmits the torque from the longitudinal universal joints cum propeller shaft to the transverse driving half axle shafts and the wheels. The final drive also multiplies the driving torque.

**Differential**allows the driving wheels on the two sides of the vehicle to rotate at the same speed when moving over a straight road and at different speeds whenever the vehicle makes a turn.

**Half-axle** drive shafts transmit the driving torque from the final drive and differential unit to the driving road wheels.

**Frame-supports** the engine, vehicle body, wheels and other components.

**Spring and wheels** transmit the vehicle load from the frame to the road.

**Special dampers** slow the resultant oscillations of the springs when the wheel hits bumpers.

**Electrical system** consists of a battery, starting motor, generator, and controls, and in case of a spark ignition power plant the engine ignition system and lighting arrangement.

Controls in a vehicle are steering system, brake system, engine control and power train control.

**Steering system** changes the direction of motion of the vehicle by turning the front wheels.

**Brake system** ensures safe driving. With this, the vehicle can be stopped quickly, or slowed down while going down a slope. The brakes are connected to the brake pedal or lever by ways of mechanical, hydraulic or air operated devices.

**Engine control** is the mechanism that permits a variation in the

Q2

Before starting to study about different types of clutch, we must know about the meaning of clutch. Clutch is defined as the device which is used in automobiles to transmit power from one rotating shaft to another shaft. In cars it transmits power from the flywheel connected to the engine shaft to the clutch shaft, and from clutch shaft it is transmitted to the rear wheels through gear shaft, propeller shaft and differential.

Mainly clutches are divided into 2 parts:

1. Friction clutches and
2. Fluid flywheel

Friction clutches:

These clutches works on the principle of friction exist in between two rotating shaft when they come in contact with each other.

Fluid flywheel:

Fluid flywheel clutches works on transfer of energy from one rotor to the other by means of some fluid. for Example: [Fluid coupling](http://www.mechanicalbooster.com/2017/06/fluid-coupling.html) and[torque converter](http://www.mechanicalbooster.com/2017/06/torque-converter.html).

Types of friction clutches:

1. Cone clutch
2. Single plate clutch
3. Multi-plate cutch
4. Semi-centrifugal clutch
5. [Centrifugal clutch](http://www.mechanicalbooster.com/2017/06/centrifugal-clutch.html)

Or

Main Parts Of clutches :

 1) The driving members consist of a flywheel mounted on the engine crankshaft. The fly wheel is bolted  to a cover which carries a pressure plate or driving disc, pressure springs and releasing levers. Thus the entire assembly of the flywheel and the cover rotate all the times. The clutch housing and the cover provided with openings dissipate the heat generated by the friction during the clutch operation.

2 ) The driven members consists of a disc or plate, called the clutch plate. It is free to slide lengthwise on the splines of the clutch shaft. It carries friction materials on both of its surface. When it is griped between the flywheel and the pressure plate, it rotates the clutch shaft through the splines.

3) The operating members consist of a foot pedal, linkage, release or throw-out bearing, release levers and the springs necessary to insure the proper operating of the clutch.

Single plate clutch:

 It is the most common type of clutch used in motor vehicles. Basically, it consists of only one clutch plate, mounted on the splines of the clutch shaft. The fly wheel is mounted on the engine crankshaft and rotates with it. The pressure plate is bolted to the flywheel through clutch springs and is free to slide on the clutch shaft when the clutch pedal is operated. When the clutch is engaged the clutch plate is gripped between the flywheel and the pressure plate. The friction linings are on both the sides of the clutch plate. Due to the friction between the flywheel, clutch plate and pressure plate, the clutch plate revolves with the flywheel. As the clutch plate revolves, the clutch shaft also revolves.

|  |
| --- |
|  |
| Single plate Clutch Working  |

Clutch shaft is connected to the transmission. Thus the engine power is transmitted to the crankshaft to the clutch shaft.

When the clutch pedal is pressed, the pressure plate moves back against the force of the springs and the clutch plate becomes free between the flywheel and the pressure plate. Thus, the flywheel remains rotating as long as the engine is running and the clutch shaft speed reduces slowly and finally it stops rotating. As soon as the clutch pedal is pressed, the clutch is said to be disengaged, otherwise it remains engaged due to the spring forces.

Q3

### 1. Manual Transmission Gearbox:

In this type of transmission different speed ratio or gear ratio is selected by the driver manually. Some special skill of driving is required to operate this type of gear box. According to their design, this is subdivided into three types.

#### (A.) Sliding mesh gear box:

When we talk about types of gearbox, this is one of the oldest type. It this, gears on the main shaft are moved right or left for meshing them with appropriate gears on the counter shaft for obtaining different speed. This type of gear box derives its name from the fact that the gears are meshed by sliding. One disadvantage of it is that, special skill is required to operate this gear box and there are high chances of wear and tear of gearbox.

#### (B.) Constant mesh gear box:

This is one of the famous type used in twenty century. It this gearbox, all the gears are in constant mesh with each other all the time. The gears on the main shaft rotates freely without rotating the main shaft. Constant mesh gear box consists two dog clutches. These clutches are provided on the main shaft, one between the clutch gear and the second gear and the other between the first gear and reverse gear. When the left side dog clutch is made to slide left by means of gearshift lever, it meshes with the clutch gear and the vehicle runs on top speed. If this clutch slide right and mesh with second gear, then the vehicle runs on second gear speed. So in constant mesh gear box we can change the gear ratio by shifting the dog clutch. This type of gear box is more popular than sliding mesh because it creates low noise and less wear of gears.

#### (C.) Synchromesh gear box:

One big problem occur in constant mesh gear box is that when the driver engage the dog clutch, the main shaft and gear to be meshed running at different speed. So when engage this gear cause wear and tear of dog clutch. This problem is solved by a synchromesh gear box. This gear box is same as the constant mesh gear box except dog clutch is replaced by synchromesh devices.

Synchromesh gear devices works on the principle that two gears to be engaged are first brought into frictional contact which equalizes their speed after which they are engaged readily and smoothly. The synchromesh looks like as the cone clutch where the outer surface of cone consist the frictional surface. This type of gear box is widely used in automobile.

### 2. Automatic Transmission Gear box:

When we talk about transmission, the automatic transmission is unforgettable. A transmission in which various speeds are obtained automatically is known as automatic transmission. In this type of gear box driver merely selects the general car condition such as forward or reverse. The selection, timing and engagement of gear for the required gear speed are accomplished automatically when the accelerator is pressed or depressed. Automatic transmission needs no gear change lever and clutch pedal since clutch and transmission is a combined unit and works automatically.

Automatic transmission is generally subdivided into two types:

#### (A.) Epicyclic gear box:

This type of gear box uses no sliding dogs or gears to engage but different gear speeds are obtained by merely tightening brake bands on gear drum. It consists of a ring gear annular wheel, sun gear and planet gears with carrier. In order to obtain different speeds any one of these units can be held from rotation by means of brake band. The ring gear contains teeth on it inner circumference and it surrounded by a brake band. The brake band is operated by a gear stick or lever to grip the ring gear and hold its movement. The sun gear is attached to the clutch shaft thus moves along with the movement of engine crankshaft. The planet gears are in constant mesh with both the sun gear and ring gear and are free to rotate on their axes carried by the carrier frame which in turn is connected to the driver shaft.

When the ring gear is locked by the brake band, the rotating sun gear causes the planet gears to rotate. Since the ring gear cannot move. The planet gears are forced to climb over it. During this position, the ring gear acts as track for the planet gears to move over. The driven shaft which is connected to the planet gear carrier is thus rotate. When the ring gear is released, it is free to move in consequence to the rotation of planet gears which rotate around their axis. During this position, there is no movement of planet carries and hence the driven shaft remains stationary. A planetary gear box contains a numbers of such units to obtain various speed reductions.

Or

### Advantages:

* Smooth and Noise free shifting of gears which is most suitable for cars.
* No loss of torque transmission from the engine to the driving wheels during gear shifts.
* Double clutching is not required.
* Less vibration.
* Quick shifting of gears without the risk of damaging the gears.

### Disadvantages:

* It is extortionate due to its high manufacturing cost and the number of moving parts.
* When teeth make contact with the gear, the teeth will fail to engage as they are spinning at different speeds which causes a loud grinding sound as they clatter together.
* Improper handling of gear may easily prone to damage.
* Cannot handle higher loads.
* Dog clutch engagements are a bit noisy.

Q4.

Hydraulic transmission, device employing a liquid to transmit and modify linear or rotary motion and linear or turning force (torque). There are two main types of [hydraulic power](https://www.britannica.com/science/hydraulic-power) [transmission](https://www.britannica.com/technology/transmission-engineering)systems: hydrokinetic, such as the hydraulic coupling and the hydraulic torque converter, which use the [kinetic energy](https://www.britannica.com/science/kinetic-energy) of the liquid; and hydrostatic, which use the pressure energy of the liquid.

The hydraulic coupling is a device that links two rotatable [shafts](https://www.britannica.com/technology/shaft-machine-component). It consists of a vaned impeller on the drive shaft facing a similarly vaned runner on the driven shaft, both impeller and runner being enclosed in a casing containing a liquid, usually oil (*see* figure). If there is no resistance to the turning of the driven shaft, rotation of the drive shaft will cause the driven shaft to rotate at the same speed. A load applied to the driven shaft will slow it down, and a [torque](https://www.britannica.com/science/torque), or turning moment, that has the same magnitude on both shafts will be developed. In a properly designed hydraulic coupling, under normal loading conditions, the speed of the driven shaft is about 3 percent less than the speed of the drive shaft. By means of a scoop tube, the quantity of liquid in a coupling and the speed of the driven shaft can be varied. Since there is no mechanical connection between the impeller and the runner, a hydraulic coupling does not transmit shocks and vibrations.

The [hydraulic torque converter](https://www.britannica.com/technology/hydraulic-torque-converter) is similar to the hydraulic coupling, with the addition of a stationary vaned member interposed between the runner and the impeller. All three elements are enclosed in a casing containing a liquid, usually oil. The effect of the stationary member is to make the torque, or turning moment, on the driven shaft greater than the torque on the drive shaft. When the driven shaft is stopped (stalled), the torque on it is a maximum and may be as much as 3.5 times the drive-shaft torque. A hydraulic torque converter acts like an infinitely variable speed transmission, delivering its higher torques when the output speed is low. In automatic transmissions for automobiles, it can be used as a partial or total substitute for a gearbox and [clutch](https://www.britannica.com/technology/clutch-machine-component).

Hydraulic transmissions of the hydrostatic type are combinations of hydraulic pumps and motors and are used extensively for [machine](https://www.britannica.com/technology/machine) tools, [farm machinery](https://www.britannica.com/technology/farm-machinery), coal-mining machinery, and printing presses. The motor and [pump](https://www.britannica.com/technology/pump) can be widely separated and connected by piping. Such a system, using pressurized water, was built in London in 1882 and is still used to drive machinery to lift bridges and operate hoists.

Or

ar wheels spin at different speeds, especially when turning. You can see from the animation that each wheel travels a different distance through the turn, and that the inside wheels travel a shorter distance than the outside wheels. Since speed is equal to the distance traveled divided by the time it takes to go that distance, the wheels that travel a shorter distance travel at a lower speed. Also note that the front wheels travel a different distance than the rear wheels.

*This content is not compatible on this device.*

For the non-driven wheels on your car -- the front wheels on a rear-wheel drive car, the back wheels on a front-wheel drive car -- this is not an issue. There is no connection between them, so they spin independently. But the driven wheels are linked together so that a single engine and transmission can turn both wheels. If your car did not have a differential, the wheels would have to be locked together, forced to spin at the same speed. This would make turning difficult and hard on your car: For the car to be able to turn, one [tire](https://auto.howstuffworks.com/tire.htm) would have to slip. With modern tires and concrete roads, a great deal of force is required to make a tire slip. That force would have to be transmitted through the axle from one wheel to another, putting a heavy strain on the axle components.

SET 2

Q1

A chassis (pronounced TCHA-see or CHA-see ) is the physical frame or structure of an automobile, an airplane, a desktop computer, or other multi-component device. *Case* is very similar in meaning, but tends to connote the protective aspect of the frame rather than its structure. People tend to choose one term or the other. The rest of this definition uses *chassis* but applies as well to the term *case* . Both terms (and *casing* ) are derived from the Vulgate Latin for *box* . The plural form is also *chassis* .

In a computer, the chassis houses the main electronic components, including the [motherboard](https://whatis.techtarget.com/definition/motherboard)(with places to insert or replace microchips for the main and possibly specialized processors and random access memory ( [RAM](https://searchstorage.techtarget.com/definition/RAM-random-access-memory) ) and places for adding optional adapters (for example, for audio or video capabilities). Typically, room is provided for a [hard disk](https://searchstorage.techtarget.com/definition/hard-disk) drive and a [CD-ROM](https://whatis.techtarget.com/definition/CD-ROM) drive.

The IBM PC chassis for its XT computers set an early de facto standard for a chassis configuration (sometimes referred to as the [form factor](https://whatis.techtarget.com/definition/form-factor)). The desktop computer has since evolved through the AT model, the mini-AT, and the small-footprint PC. A later development was the vertical or tower chassis configuration, designed to be placed under a desk. The outer dimensions of a chassis are said to form its [footprint](https://whatis.techtarget.com/definition/footprint) .

The term is not usually applied to mobile and notebook computers perhaps because the hardware components have to be more tightly integrated. Some communications devices such as terminal servers have a chassis especially designed to handle many combinations of hardware add-ons. Such a chassis is described as *modular* .

OR

1.         Front Engine - Rear Wheel Drive

In this layout a front mounted engine-clutch-gear box unit drives a beam type rear axle suspended on leaf sprints through a propeller shaft with two universal joints. With the help of coil sprints, the front wheels are independently sprung. As shown in Fig. 1.4 this layout is one of the oldest layout which remained unchanged for many years. some of the advantages provided by this system are :

            (a)        Balanced weight distribution between the front and the rear wheels.

            (b)        Easy front wheel steering.

            (c)        Behind the rear seats, large luggage space is available.

            (d)       Accessibility to various components like engine, gearbox and rear axle is better in  comparison to other layouts. The control linkages-accelerator, choke, clutch and gearbox are short and simple.

            (e)        Full benefits of the natural air stream created by vehicle’s movement is taken by the forward radiator resulting in reduced power losses from a large fan.

            (f)        Small length of the propeller shaft permits the angularity of the universal joints to be small and easily provided by simple types.

            By mounting the rear wheel drive assembly on the body unit and using universally jointed shafts to independently steer rear wheels as shown in Fig. 1.5, the layout design can be modified and improved. It provides number of benefits like improved handling, comfort and rear wheel grip as well as reduced unspring weight.

2.         Rear engine-Rear wheel drive

            This arrangement eliminates the necessity for a propeller shaft when the engine is mounted adjacent to the driven wheels. The engine-clutch-gear box-final drive form a single unit in this layout. As shown in Fig. 1.6, to reduce the ‘overhang’ distance between the wheel centres and the front of the engine, the final drive is generally placed between the clutch and the gear box. In comparison to front wheel drive it has a simpler drive shaft layout. Further, the weight of rear engine on the driving wheels provides excellent tranction and grip especially on steep hills as well as when accelerating. Inspire of the low proportion of the vehicle weight transferring to the front wheels, very effective rear wheel braking is possible. Due to the absence of the propeller shaft the obstructed floor space is reduced. The front of the vehicle can, therefore, be designed for good visibility and smooth air flow. the exhaust gases, fumes, engine heat and noises are also carried away from the passengers. It results in compact layout and short car.

            The layout also has got certain disadvantages like restricted luggage space due to narrow front compartment which houses the fuel tank also. Natural air cooling is not possible, it requires a powerful fan. The floor is further obstructed due to long linkage required for the engine, clutch and the gear box controls. The rearward concentration of weight causes the vehicle to be more affected by side winds at high speeds. this makes the vehicle unstable resulting in over steering and turning very sharply into a curve. This necessitates the steering correction in the opposite direction.

3.         Front engine-front wheel drive.

            This layout provides optimum body-luggage space and a flat floor line resulting in a transverse longitudinal engine position. This drive pulling the car along provides good grip and good road holding on curves due to major weight at the front. The chances of skidding especially on slippery surfaces are very much reduced. Good road adhesion is provided by the large proportion of the vehicle weight acting on the driven wheels. when the vehicle is to be ‘steered in’ to the curve, it provides ‘understeer’ characteristics always preferred by drivers.

The combination of steered and driven wheels with short drive shafts provides the main disadvantage. This requires special universal joints and a more complicated assembly. to prevent the rear wheels from skidding under heavy braking, the ‘reduced’ weight at the rear usually necessitates special arrangement.

4.         Front wheel steering Rear wheel drive

            1.         Access to the engine is very easy.

            2.         Slowing down of the water circulation causing cooling troubles can be avoided and long hose connections can be saved due to situating of the radiator in the main air stream.

            3.         This arrangement helps minimize the linkage between the clutch, gear box and engine.

            4.         The angularity of the propeller shaft is kept to minimum and there is no need of joints due to the shaft length.

Rear Engine-Rear Wheel Drive

Advantages

1.  Better road adhesion preferably on steep hills and while accelerating with increased weight on the driving wheels.

2.         Generally a proportional part of weight of the car is transferred to the front wheels while braking. Therefore, due to the firm road surface contact maintained by rear engined car results in assistance to stopping of the vehicle.

3.         In this arrangement, front wheels are only for steering purposes.

4.         The necessaity of the propeller shaft is altogether eliminated due to the combination of engine, gear box and final drive. This also requires only one common oil sump.

5.         Good visibility and stream lining is provided by proper design of vehicle front.

6.         The passengers are kept away from inconveniences like noise, heat and fumes.

Disadvantages

 1.        At high speed, the increased weight at the rear end makes the vehicle unstable.

2.         To control the engine, clutch and gear box, long linkages are required.

3.         The width of the car at the front gets reduced for accommodating the movement of the steering wheels resulting in reduction of size of the luggage compartment for given length and with of the car.

  4.       The wheels get turned too sharply into the curve due to tendency of over-steering.  This necessitates the turning of the steering wheels in the opposite direction to make correction by the driver.

5.         Efficient cooling becomes very difficult to obtain due to screening of the engine by the vehicle body.

Front Engine - Front Wheel Drive

Advantages

1.         As compared to rear wheel driven car, there is a faster and safer travelling due to good road holding on curves.

2.         Good road adhesion is obtained due to a large part of the vehicle’s weight being carried on the driving wheels under normal conditions.

3.         Under-steer conditions generally preferred by many drivers are promoted by this type of drive. The car comes back to closer radius if the throttle is released. This makes the steering wheel to run more in the direction of turn to make it a better condition.

4.         A lower flat floor lines is provided due to dispensing with the propeller shaft resulting in lowering of centre of gravity.

5.         The engine, clutch, gear box and final drive are combined similar to the rear engine car. This provides a more comfortable drive due to final drive spring.

Disadvantages

1.         Due to the weight of the vehicle moving to the rear, the weight on the driving wheels is reduced on steep gradients as well as while accelerating.

2.         The tractive effort which is most needed on steep gradients and during accelerating is reduced.

3.         This disadvantage becomes more serious on slippery gradients.

4.         Under these conditions certain modifications in modern designs have been made to ensure provision of sufficient traction.

5.         Four-wheels drive

To increase maneuverability of the vehicle required to travel on rough unconstructed roads and tracks another arrangement known as four-wheel drive is provided. due to all the four wheels getting driven, whole of the weight of the vehicle is available for traction. But this advantage is not worth the additional cost on good road surfaces. The system is provided in jeeps which are known as 4 X 4 wheel drive vehicles.

6.         Left hand and Right and drives

In different countries, the automobiles are driven on different sides of the road, In United Kingdom and all the countries, which were once colonies of the British Rule. The vehicles are driven on the left hand side of the road. In all other countries of the world, normally vehicles are driven on the right hand side of the road. For better driving control, the vehicle drivers must be nearer to one another while passing or crossing. Similarly for safety consideration, the drivers must be in the centre of the road while driving. Therefore, two types of vehicles are manufactured.

            (a)        Left hand drive: The steering is fitted on the left hand side of the automobile and such vehicles are convenient to drive in countries following right hand drive rules, e.g. U.S.A., Russia, European countries.

            (b)        Right hand drive :  The steering is fitted on the right hand side of the automobile and such vehicles are convenient to drive in countries following left hand drive rules, e.g. U.K., India, Pakistan. However, though rare, left hand cars also driven in such countries.

Q2

Before starting to study about different types of clutch, we must know about the meaning of clutch. Clutch is defined as the device which is used in automobiles to transmit power from one rotating shaft to another shaft. In cars it transmits power from the flywheel connected to the engine shaft to the clutch shaft, and from clutch shaft it is transmitted to the rear wheels through gear shaft, propeller shaft and differential.

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[Centrifugal clutch](http://www.mechanicalbooster.com/2017/06/centrifugal-clutch.html)

Or

The most popular form found in [automobiles](https://en.wikipedia.org/wiki/Automobiles) is the [hydraulic](https://en.wikipedia.org/wiki/Hydraulic)automatic transmission. Similar but larger devices are also used for heavy-duty commercial and industrial vehicles and equipment. This system uses a [fluid coupling](https://en.wikipedia.org/wiki/Fluid_coupling) in place of a friction [clutch](https://en.wikipedia.org/wiki/Clutch), and accomplishes gear changes by hydraulically locking and unlocking a system of [planetary gears](https://en.wikipedia.org/wiki/Epicyclic_gearing). These systems have a defined set of gear ranges, often with a [parking pawl](https://en.wikipedia.org/wiki/Parking_pawl) that locks the output shaft of the transmission to keep the vehicle from rolling either forward or backward. Some machines with limited speed ranges or fixed engine speeds, such as some [forklifts](https://en.wikipedia.org/wiki/Forklift) and [lawn mowers](https://en.wikipedia.org/wiki/Lawn_mower), only use a [torque converter](https://en.wikipedia.org/wiki/Torque_converter) to provide a variable gearing of the engine to the wheels.

Besides the traditional hydraulic automatic transmissions, there are also other types of automated transmissions, such as a [continuously variable transmission](https://en.wikipedia.org/wiki/Continuously_variable_transmission) (CVT) and [semi-automatic transmissions](https://en.wikipedia.org/wiki/Semi-automatic_transmission), that free the driver from having to shift gears manually, by using the transmission's computer to change gear, if for example the driver were [redlining](https://en.wikipedia.org/wiki/Redline) the engine. Despite superficial similarity to other transmissions, traditional automatic transmissions differ significantly in internal operation and driver's feel from semi-automatics and CVTs. In contrast to conventional automatic transmissions, a CVT uses a belt or other torque transmission scheme to allow an "infinite" number of gear ratios instead of a fixed number of gear ratios. A semi-automatic retains a clutch like a manual transmission, but controls the clutch through [electrohydraulic means](https://en.wikipedia.org/wiki/Electrohydraulic_manual_transmission). The ability to shift gears manually, often via paddle shifters, can also be found on certain automated transmissions ([manumatics](https://en.wikipedia.org/wiki/Manumatic) such as [Tiptronic](https://en.wikipedia.org/wiki/Tiptronic)), semi-automatics (BMW SMG, VW Group [DSG](https://en.wikipedia.org/wiki/Direct-shift_gearbox)), and CVTs (such as [Lineartronic](https://en.wikipedia.org/wiki/Lineartronic#Subaru_Lineartronic_CVT)).

The obvious advantage of an automatic transmission to the driver is the lack of a clutch pedal and manual shift pattern in normal driving. This allows the driver to operate the car with as few as two limbs (possibly using assist devices to position controls within reach of usable limbs), allowing individuals with disabilities to drive. The lack of manual shifting also reduces the attention and workload required inside the cabin, such as monitoring the tachometer and taking a hand off the wheel to move the shifter, allowing the driver to ideally keep both hands on the wheel at all times and to focus more on the road. Control of the car at low speeds is often easier with an automatic than a manual, due to a side effect of the clutchless fluid-coupling design called "creep" that causes the car to want to move while in a driving gear, even at idle. The primary disadvantage of the most popular hydraulic designs is reduced mechanical efficiency of the power transfer between engine and drivetrain, due to the fluid coupling connecting the engine to the gearbox. This can result in lower power/torque ratings for automatics compared to manuals with the same engine specs, as well as reduced fuel efficiency in city driving as the engine must maintain idle against the resistance of the fluid coupling. Advances in transmission and coupler design have narrowed this gap considerably, but clutch-based transmissions (manual or semi-automatic) are still preferred in sport-tuned trim levels of various production cars, as well as in many auto racing leagues.

Q3.

Sliding mesh gear boxes are made with spur gear. The gears in the layshaft is rigidly fixed shaft. The gears in main shaft alone can move along the spline. The selector fork moves the gear and moves the perfect mesh with the required gear in lay shaft when the gear lever is shifted. A idler gear is provided for reverse gearing. Thus the power form the clutch shaft is transmitted to the main shaft through the lay shaft.

First gear
In the first gear, the gearbox provides maximum torque at low speed. The smallest gear on the lay shaft engages with the biggest gear in main shaft, thus transmitting high torque.

 1st gear                                                                                                                       2ndgear

Second gear

In the second gear, the gearbox provides low  torque and high speed when compared to 1st gear .

Third gear
In the third gear, the gearbox provides low  torque and high speed when compared to 2nd gear

                                               3rd gear                                                                                                                     4thgear

Fourth gear
For fourth gear the clutch shaft and the main shaft is engaged by a dog clutch, thereby the main shaft rotates at maximum speed as that of clutch shaft.

Reverse gear

When selecting reverse, the direction of rotation of the output shaft is changed This is achieved by using an idler gear.The idler gear is meshed between a counter shaft gear (layshaft or 2nd motion shaft) and an output shaft gear(mainshaft or 3rd motion shaft).

Or

A planetary gearbox is a gearbox with the input shaft and the output shaft aligned. A planetary gearbox is used to transfer the largest torque in the most compact form (known as torque density).

The bicycle’s acceleration hub is a great example of a planet-wheel mechanism: Have you ever wondered how you can get so much power and capabilities in such a little hub? For a three-speed hub, a one-stage planetary gear system is used, for a five-speed hub a 2-stage. Each planet gear system has a reduction state, a direct coupling and an acceleration mode.

In mathematical terms, the smallest reduction ratio is 3: 1, the largest is 10: 1. At a ratio of less than 3, the sun gear becomes too big against the planet gears. At a ratio greater than 10 the sun wheel becomes too small and the torque will drop. The ratios are usually absolute i.e. an integer number.

Whoever invented the planetary gearbox is not known, but was functionally described by Leonardo da Vinci in 1490 and has been used for centuries.

## Why is it named a planetary gearbox?

The planetary gearbox got its name because of how the different gears move together. In a planetary gearbox we see a sun (solar) gear, satellite (ring) gear and two or more planet gears. Normally, the sun-gear is driven and thus move the planet gears locked in the planet carrier and form the output shaft. The satellite gears have a fixed position in relation to the outside world. This looks similar to our planetary solar system and that is where the name comes from. What helped was that ancient gear constructions were used extensively in astrology for mapping and following our celestial bodies. So it was not such a big step to make.

In practice, we often speak from the perspective of the use of planetary gearboxes for industrial automation. That is why we call the sun-gear the input shaft, the planet gears and carrier the output shaft and the satellite gear (or ring gear) the housing.

Q4

## **Hotchkiss Drive:**

* The Hotchkiss drive is simplest and most popular form of rear axle suspension.
* Hotchkiss drive combines the springing and positioning or locating of the rear axle. It uses a rigid axle with leaf spring mounted at its extremities as far apart as possible on the rear axle.
* The Hotchkiss drive consists of a leaf spring and a propeller shaft with two universal joints and one sliding joint.
* The front end of the leaf spring is pivoted in pin of bracket which is bolted to the vehicle frame.
* While rear end of the leaf spring is supported in swinging shackle with antifriction bush material.
* The leaf springs are bolted rigidly to the rear axle casing at middle.
* The spring takes weight of body, torque reaction and driving thrust.
* The driving and braking torques are absorbed through the front half of the rear leaf spring shown by dotted line.
* During driving and braking, the bevel pinion changes the position so the length and angle of propeller shaft changes which will be adjusted by universal joint and sliding joint. Therefore if only one universal joint is at the front end, then the propeller shaft may bend or damage.
* To avoid this, another universal joint is provided at rear end.
* When the vehicle comes across a bump or shocks, the rear axle moves up and down and it has to move in a circle with front spring supported at the frame as centre.
* During this movement of rear axle, the length of the propeller shaft changes which will be adjusted by sliding joint.

**Torque tube drive:**

* In torque drive, the propeller shaft is enclosed in a hollow tube.
* The tube is rigidly bolted to the differential housing at one end and is fastened at the other end to the transmission through a somewhat flexible joint (universal joint) situated in spherical cup fixed to the frame.
* The torque reaction and driving thrust are taken up by torque tube.
* When the vehicle comes across a bump or shocks, the centre line of the bevel pinion shaft will not be shift and always passes through the centre of spherical cup.
* Hence, only one universal joint is required at front end and no universal joint at the rear end.
* The tube incorporates bearing, which support the propeller shaft.
* It is usually located between the (transmission) gear box and the propeller shaft.
* No sliding joint is required in the propeller shaft.
* In many cars a pair of truss rods is attached between the rear axle housing and the transmission end of the torque tube. The torque tube and the truss rod brace the differential housing to prevent excessive differential housing movement.
* In this drive, the leaf springs takes only the side thrust besides supporting weight of the body.