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	Record No.: ADM/D/036B Revision: 00	DoI: 21/01/2019	
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QUESTION BANK

Unit 1. FRAME AND BODY & CHASSIS LAYOUT

(Prof.S.V.Raut)

Multiple Choice Question



1. What is an Automobile?
 - a) self-propelled vehicle
 - b) used for carrying passengers and goods on the ground
 - c) contains the power source for its propulsion
 - d) All of the mentioned

2. . Automobile can be classified based on which of the following parameter?
 - a) Fuel Used
 - b) Transmission
 - c) Drive
 - d) All of the mentioned



3. Which of the following is a classification of automobiles based on Load?
 - a) Heavy transport vehicle (HTV)
 - b) Sedan Hatchback car
 - c) Four wheeler vehicle
 - d) Front-wheel drive

4. Which of these were or are used in automobiles to provide suspension.
 - a) Coil springs
 - b) Torsion bars
 - c) Leaf springs
 - d) All of the mentioned.



5. Which of the following is a classification of IC Engine?
 - a) Otto cycle engine

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- b) Four-stroke engines
c) S.I Engines
d) All of the above
6. What is the function of the alternator?
a) **Recharging the Battery**
b) Voltage Regulator
c) Auto-ignition
d) None of the above
7. Which of the following is found in an automobile's electrical system?
a) Lighting systems
b) Battery
c) Alternators
d) **All of the mentioned**
8. Which of the following parts does not include an automobile chassis?
a) **Differential**
b) Brakes
c) Steering system
d) Shock absorbers
9. Which of the following type of load is supported by an automobile frame?
a) Torque from engine and transmission
b) Sudden impacts from collisions
c) Weight of the body, passengers and cargo loads
d) **All of the mentioned**
10. What is an IC Engine?
a) **the fuel is ignited and burned inside the engine**
b) the fuel is burned inside a combustion chamber
c) the fuel is ignited inside a combustion chamber
d) None of the above

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11. The temperature of the piston will be more at _____ in an automobile engine.
- The piston rings
 - The piston walls
 - The crown of the piston
 - The skirt of the piston
12. What is the angle between the steering axis and the vertical in the plane of the wheel? a)
- Castor
- Camber
 - Steering axis inclination
 - Kingpin inclination
13. If the front of the front wheels is inside and rear of front wheels are apart when the vehicle is at rest, then the configuration is called?
- a) Toe-in
- Toe out
 - Positive camber
 - Positive castor
14. What is the name of the angle through which the wheel has to turn to sustain the side force?
- a) Slip angle
- Castor angle
 - Camber
 - Kingpin inclination
15. What is called the cornering force over the slip angle?
- Castor trail
 - Cornering power
 - Self-righting torque
 - Pneumatic trail
16. What is a condition called when the vehicle will try to move away from its normal direction and to keep it on the right path there is need to steer a little?

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a) Understeer

b) Oversteer

c) Reversibility

d) Irreversibility

17. What is the purpose of the reciprocating ball type steering gear?

a) To reduce the operating cost

b) To reduce the number of parts

c) To reduce the operating friction

d) To reduce the toe-out during the turns

18. What is the angle between the vertical when the top of the wheel slants outward?

a) Negative camber

b) Negative castor

c) Positive camber

d) Positive castor

19. In the steering gear, a gear sector or toothed roller is meshed with a

a) ball bearing

b) roller bearing

c) worm

d) steering wheel



20. Caster action on the front wheels of a vehicle will

a) make it easier for the driver to take corners

b) help reduce the load on the king-pins

c) automatically achieve the straight wheel position

d) none of the mentioned

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Answers for Question Banks of Motor Vehicle Technology

Unit 1. FRAME AND BODY & CHASSIS LAYOUT

1. What are the main component in Engine Power Plant?

(i) Air and fuel supply system

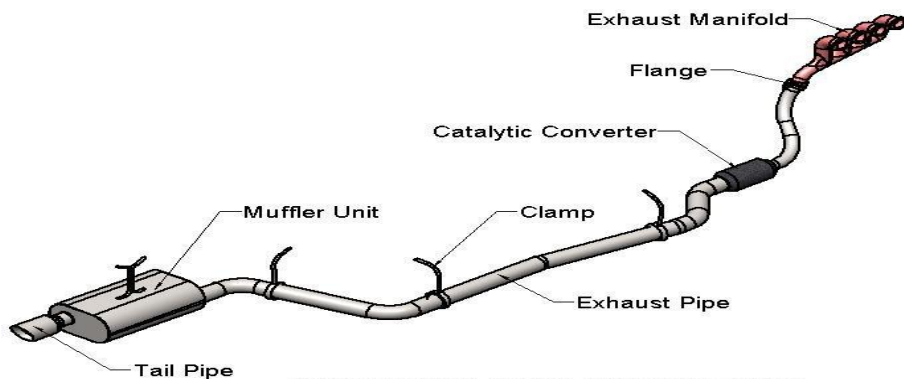
- The engine takes in fresh air from the atmosphere through an air filter.
- Fuel is pumped from the fuel tank and injected in the intake manifold for a petrol engine, while injected in the cylinder directly for a diesel engine.

(ii) Engine



- The engine converts the heat energy generated by burning of fuel into mechanical energy.
- The burned fuel is forced out of the engine in the exhaust system.





(iii) Exhaust system

- The functions of the exhaust system are as follows :
 - Provide an easy passage to the flow of exhaust gases from the cylinder to the atmosphere.
 - To treat the exhaust gases (oxidize the unburnt fuel) before release to the atmosphere.
 - Damp the noise levels of the high speed exhaust gases.



Typical Exhaust System of Passangrer Car

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COMPONENT	PURPOSE
Exhaust manifold 	Moves the post-combustion gases to the exhaust pipe
Catalytic converter 	Lowers the emissions of the vehicle so that the air from the exhaust is less polluted
Middle piping (cross piping) 	Houses the resonator
Resonator 	Middle piping connects the resonator and the muffler at the rear of the vehicles First stage in quieting the engine
Muffler 	Quiets or "muffles" the engine

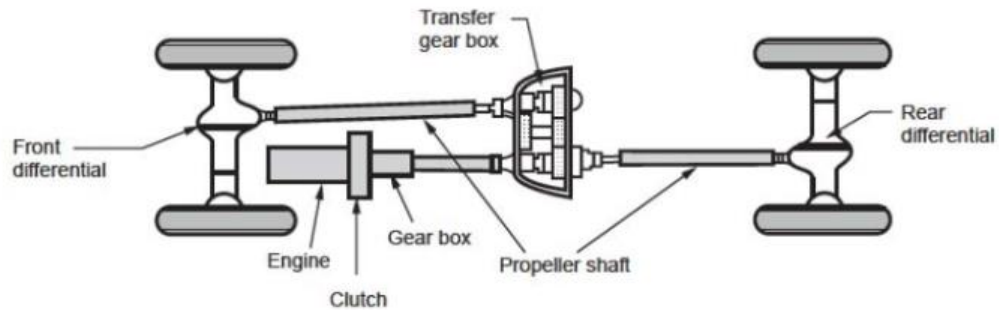
2. Explain with neat Sketch the following layouts. a. Four Wheel Drive b. RERW Drive

- Front Engine Rear Wheel Drive
- Front Engine Front Wheel Drive
- Rear Engine Rear Wheel Drive
- All Wheel Drive

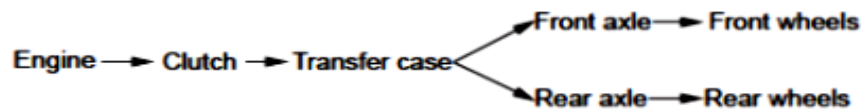
- Sometimes while driving on rural or uneven or rough unconstructed roads, automobile with conventional layout (2 - wheel drive) gets stuck in the pothole.
- It becomes difficult for driver to get the automobile out of the pothole or ditch.
- The case is more severe if the drive wheel itself gets stuck in such a pothole or ditch.
- Hence to provide better maneuverability i.e. drive and traction on all the four wheels of the vehicle, a four wheel drive train is used.



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• The drive chain for this layout is :



- An Additional lever is provided in cabinet to engage and disengage the 4WD.
- **Advantages**
 1. Better traction at all four wheel
 2. Excellent road handling characteristics
 3. Can be run on off road conditions
- **Limitation**
 1. Very high weight and cost
 2. Accessibility to various components is difficult due to complicated design
 3. Requires special transfer case

Rear Engine Rear Wheel Drive



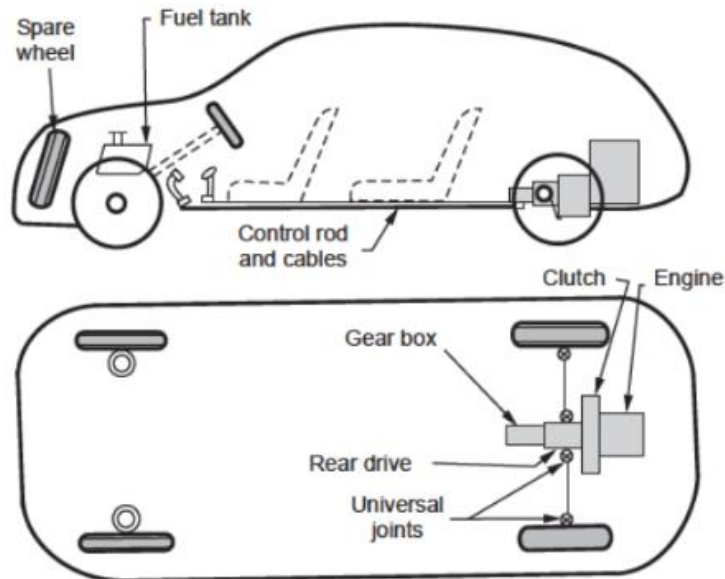
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- This type of lay out remove the necessity of the propeller shaft
- **Advantages**
 1. Front Axle consist of simple design and house the steering mechanism only
 2. Because of heavy weight of the driving axel it provide high traction at the steep hill
 3. At front body any styling design can be accommodate.
- **Limitation**
 1. Natural Cooling of the engine cannot be possible i.e. Need powerful radiator fan.
 2. Clutch, gear shifting mechanism long and Complex
 3. Chances of over steer at sharp corners, as high weight at rear

3. Explain different types of Automobiles.

1. On the Basis of Load:-



- a. Heavy transport vehicle (HTV) or heavy motor vehicle (HMTV),
- b. Light transport vehicle (LTV), Light motor vehicle (LMV)

2. On the Basis of Wheels

- c. Two wheeler vehicle, for example : Scooter, motorcycle, scooty, etc.
- d. Three wheeler vehicle, for example : Autorickshaw,
- e. Three wheeler scooter for handicaps and tempo, etc.
- f. Four wheeler vehicle, for example : Car, jeep, trucks, buses, etc.
- g. Six wheeler vehicle, for example : Big trucks with two gear axles

3. On the basis of Fuel Used:

- h. Petrol vehicle, e.g. motorcycle, scooter, cars, etc.
- i. Diesel vehicle, e.g. trucks, buses, etc.
- j. Electric vehicle which use battery to drive.
- k. Steam vehicle, e.g. an engine which uses steam engine.

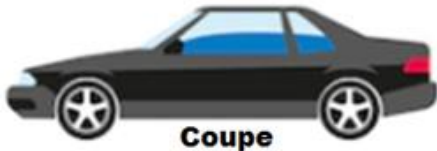
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1. Gas vehicle, e.g. LPG and CNG vehicles, where LPG is liquefied

4. On the basis of body style:

- Sedan & Hatchback car.
- Coupe car Station wagon Convertible.

Van Special purpose vehicle, e.g. ambulance, milk van, etc



5. On the basis of Transmission:



- Conventional vehicles with manual transmission, e.g. car with 5 gears.
- Semi-automatic
- Automatic : In automatic transmission, gears are not required to be changed manually

6. On the basis of Drive:

- Left hand drive
- Right hand drive

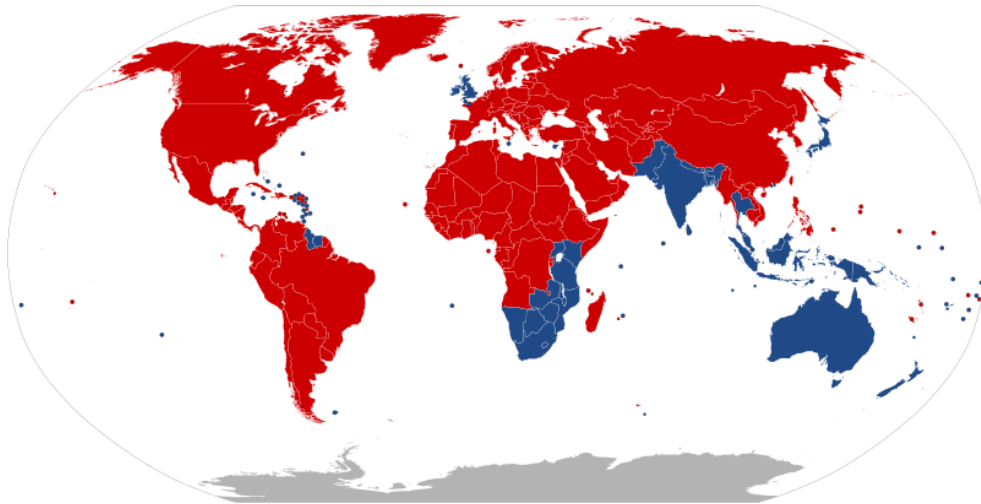
7. On the basis of Driving Axle

- Front wheel drive
- Rear wheel drive
- All wheel drive

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8. Position of Engine:

- Engine in Front - Most of the vehicles have engine in the front. Example : most of the cars,
- Engine in the Rear Side Very few vehicles have engine located in the rear. Example : Nano car.



4. What are the different major component in automobile system

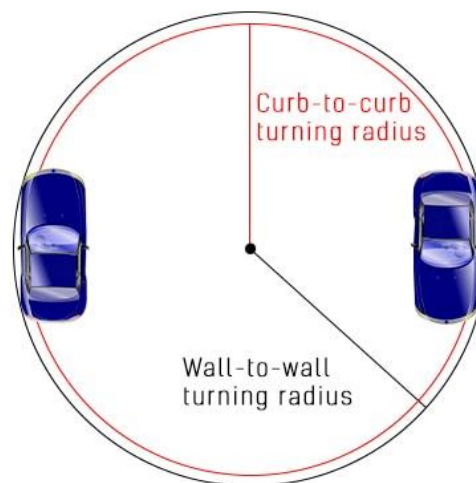
Sr. No.	Major Component/ System	Elements	
1	The Basic Structure	<ul style="list-style-type: none"> • Frame •Suspensin System 	<ul style="list-style-type: none"> • Axel • Wheels
2	The Power Plant(Engine or Source of Power)	<ul style="list-style-type: none"> • Air and FueleSupply system • Engine • Exhaust System(Petrol or Diesel or Other) 	
3	The Power Train (Transmission System or Gear Box)	<ul style="list-style-type: none"> • Clutch • Gear Box 	<ul style="list-style-type: none"> • Propeller Shaft • Differential
4	The Body (Superstructure		

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5	The Controls	<ul style="list-style-type: none"> • Steering • Accelerator Paddle 	<ul style="list-style-type: none"> • Clutch Paddle • Gear Shifter
6	The Auxillary	<ul style="list-style-type: none"> • Electrical Supply System • Fuel System • Lubrication System • Cooling System 	

5. Write Short Notes on: -Turning radius, lock-to-lock angle and centre point steering.

Turning radius:- It is the radius (**or the diameter**) of the circle made by the outer wheels of the vehicle while making a complete turn. Naturally, turning circle differs for every kind of vehicle. Legally, manufacturers must specify the turning circle radius or diameter.



Lock-To-Lock Angle :- Steering wheel lock to lock angle is **the total rotating capacity of the steering wheel** (i.e. -270° to $+270^\circ$). Steering Ratio is the ratio of Input from the steering wheel (in degrees) to the output on the wheels (in degrees).

Centre Point Steering:-



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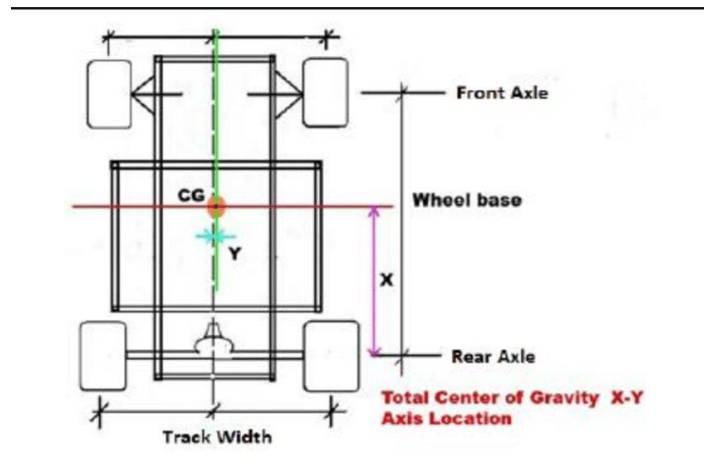
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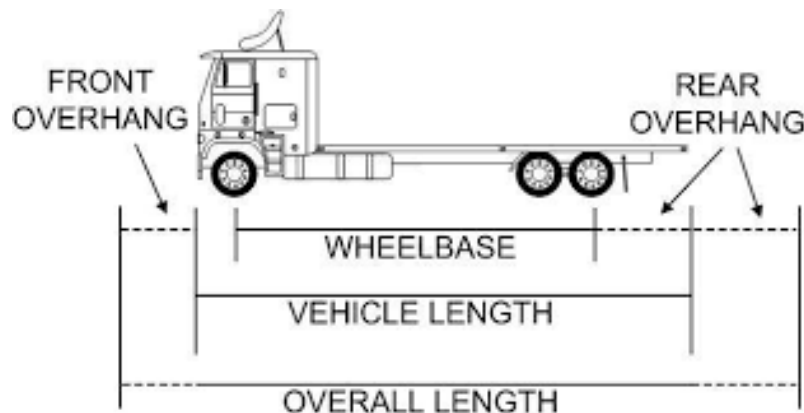
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7. Definitions of items-wheel track, wheel base, front and rear overhang, kerb weight, ground clearance.

Wheel Base and track : - In both road and rail vehicles, the wheelbase is **the horizontal distance between the centers of the front and rear wheels**. For road vehicles with more than two axles (e.g. some trucks), the wheelbase is the distance between the steering (front) axle and the center point of the driving axle group.



Front And Rear Overhang:-Overhangs are **the lengths of a road vehicle which extend beyond the wheelbase at the front and rear**. They are normally described as front overhang and rear overhang. Practicality, style, and performance are affected by the size and weight of overhangs.



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QUESTION BANK

Unit 2. DRIVE SYSTEM

(Prof.S.V.Raut)



Multiple Choice Question

- If there are 7 clutch plates in a multi-plate clutch, what is the number of pair of contact surfaces?
 - 5
 - 4
 - 6
 - 8
- External diameter of the clutch facing is limited to 120 mm and the inner diameter may be assumed to be 0.3 times the external diameter. Assume uniform wear theory. What is the effective mean radius?
 - 68
 - 58
 - 98
 - 78

Answer: d

Explanation: External diameter = 120 mm. Given Internal diameter = $0.3 \times \text{external diameter} = 0.3 \times 120 = 36$ mm. Effective mean diameter = $(120 + 36) / 2 = 78$ mm \Rightarrow Effective mean radius = 39 mm.

- Which of the following contains no linkage between the clutch and the pedal?
 - Clutch – by – wire
 - Wet clutch
 - Hydraulic single plate clutch
 - Hydraulic multi-plate clutch
- here is the clutch located?
 - Between transmission and engine



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- b) Between transmission and rear axle
c) Between transmission and propeller shaft
d) Between transmission and differential
5. Which of the following parts of the cover assembly that hold the pressure plate against the clutch plate?
a) Springs
b) Thrust bearings
c) Struts
d) Lever
6. Which of the following is the coefficient of friction of the clutch plate?
a) 1.3
b) 0.8
c) 0.4
d) 0.1



Answer: c

Explanation: The coefficient of friction is always less than 1. Most commonly used material for the clutch plate is ceramic in case of racing cars, heavy loads, etc.

7. Which of the following is the disadvantage of the cone clutch?
a) It becomes difficult to disengage the clutch when the cone angle is less than 20°
b) It is silent in operation
c) The normal force on the contact surface is larger than the axial force
d) Same torque can be transmitted for the same size as the plate clutch
8. The dry clutch can tolerate longer engagement time than a wet clutch.
a) True
b) False Explanation: Since metal to oil heat transfer is more effective than the metal to the air, the wet clutch acts as a much better heat exchanger and wet clutch can tolerate longer engagement time.

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9. Which of the following is the need of the gearbox?
- To vary the speed of the vehicle
 - To vary the torque of the vehicle
 - To vary the power of the vehicle
 - To vary the acceleration of the vehicle
10. In which type of manual transmission the double-declutching is used?
- Constant-mesh gearbox
 - Sliding mesh gearbox
 - Synchromesh gearbox
 - Epicyclical gearbox
11. In which of the gearbox sun and planet gear set is used?
- Constant-mesh gearbox
 - Sliding mesh gearbox
 - Synchromesh gearbox
 - Epicyclical gearbox
12. Which of the following is not part of automatic transmission?
- Epicyclic gearbox
 - Torque convertor
 - Multi-plate clutch
 - Sliding mesh gearbox
13. Why are the helical gears used commonly in transmission over spur gears?
- Low cost and high strength
 - Low noise level and high strength
 - Low noise level and economy
 - Low noise level and low cost

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Answer: b

Explanation: The teeth profile on the helical gear is at an angle to the axis of the gear because of which helical gears produce less noise during operation and also they have high strength.

14. Increase of torque in a vehicle is obtained by decreasing power.

- a) True
- b) False

Answer: b

Explanation: Increase of torque in a vehicle is obtained by decreasing speed. As we know $P = 2\pi NT/60$ for the same power (P), T (torque) is inversely proportional to N (speed).

15. Which types of joints are used when the shafts are inclined?

- a) Universal joint
- b) Hinge joint
- c) Ball and socket joint
- d) Pivot joint

16. Which of the following is the disadvantage of the open differential?



- a) High in cost
- b) Not reliable
- c) Complex design
- d) Sends most of the power to the wheel having less traction

Answer: d

Explanation: The major disadvantage of the open differential is that it transfers the power to the wheel even if it is on a slippery road. That's why it is not used in off driving cars.

17. Where is the differential located?

- a) Between transmission and rear axle
- b) Between engine and transmission

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- c) Between two propeller shaft
- d) Between steering wheel and steering column

18. What is the need of the universal joint?



- a) To change inclination
- b) To bend sideways
- c) To transfer torque at an angle**
- d) To change length

19. A two-piece propeller shaft requires one universal joint.

- a) True
- b) False**

Answer: b

Explanation: A two-piece propeller shaft requires a center support bearing. If there is a large wheelbase, the long propeller shaft is needed. So a two-piece propeller shaft is used in such case with a center support bearing. By incorporating this there is no sag or whirl.

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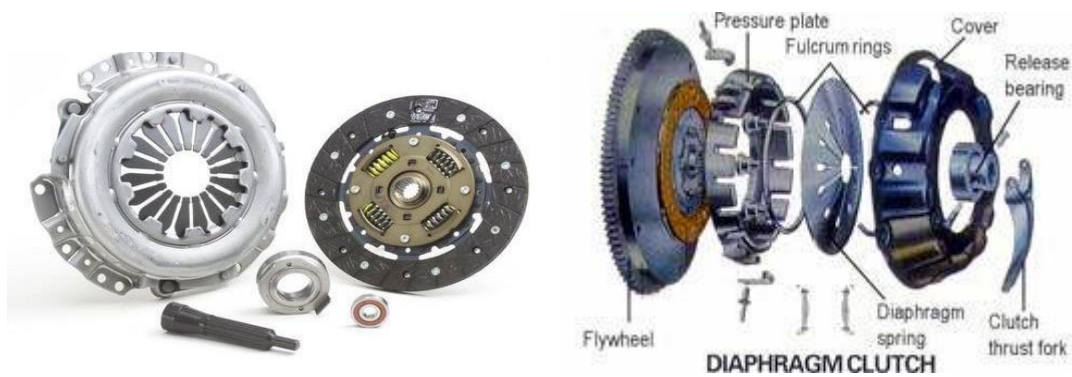
Unit 2. DRIVE SYSTEM

1. What is necessity of clutch and what are functions as well as different types?

- In manual transmission motorcycles, the clutch is the component in the engine that engages and disengages power from the engine to the transmission in order to change gears. In other words, it enables the rider to turn on or off power to the rear wheel to change gears.
- Clutch is the mechanism to transmit the rotary motion from one shaft (Driving Shaft) to another shaft(Driven Shaft) as and when it requires.
- Function of transmitting the torque from the engine to the drive train. Smoothly deliver the power from the engine to enable smooth vehicle movement. Perform quietly and to reduce drive-related vibration.

Characteristics/ Requirement of Clutch

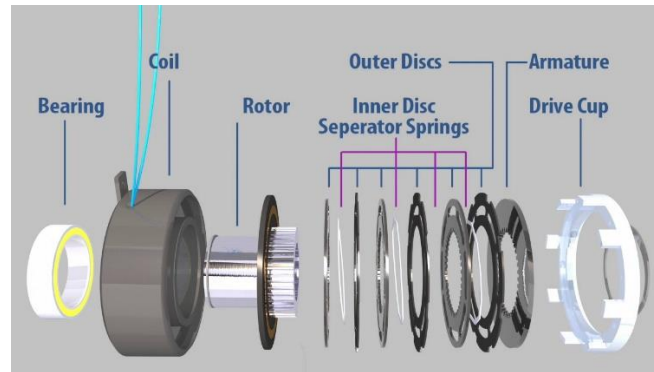
- Torque Transmission
- Gradual Engagement
- Dissipation of Heat
- Dynamic Balancing
- Vibration Damping
- Clutch Size
- Ease of operation



Single Plate Clutch



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Multi Plate Clutch

2. What are the different resistance in vehicle motion

1. Air or Wind Resistance

(i) Air or Wind Resistance (R_A) :

- It is the resistance offered by air to the passage of vehicle through it.
- The resistance offered depends on size of vehicle, its shape and the vehicle speed.
- For a particular vehicle, the size and shape is fixed.
- Hence, air resistance varies with vehicle speed.
- It usually varies as the square of vehicle speed.

$$\text{Air resistance } (R_A) = \mu_{AR} \cdot A \cdot (V)^2$$

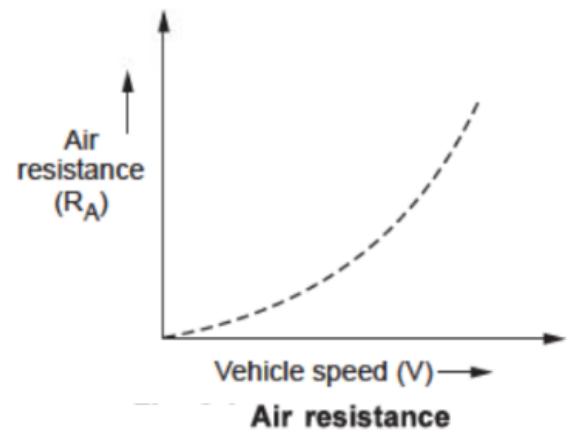
Where,

R_A = Air or wind resistance

V = Vehicle speed

μ_{AR} = Co-efficient of air resistance

A = Frontal area of vehicle



2. Gradient Resistance



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- It is the extra effort required to drive the vehicle on a gradient as compared to that required to drive on a horizontal road surface.
- When the vehicle is moving up a gradient, the component of vehicle load parallel to the gradient surface prevents the vehicle from moving up. This force is representative of the gradient resistance.
- Gradient resistance depends on the steepness of the gradient and vehicle weight and is independent of vehicle speed.
- It is expressed as $R_G = W \cdot \sin \theta$ or $\frac{W}{G}$

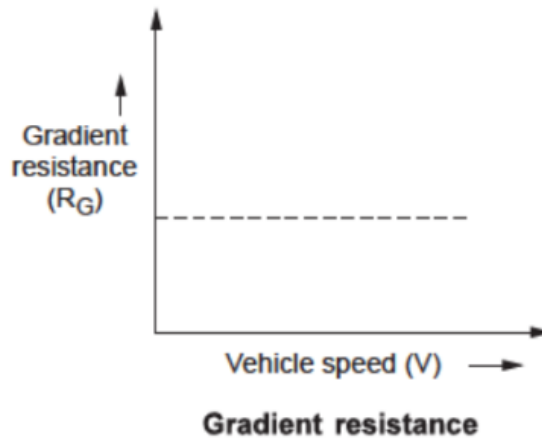
Where, θ = Inclination of slope.

When expressed as a percentage,

Percentage grade = $\tan \theta \times 100$

but for small values of θ , $\tan \theta \approx \sin \theta$

G = Gradient (say 1 in 5)



3.Rolling or Miscellaneous Resistance



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- All remaining external resistances make up the rolling or miscellaneous resistance.
- It includes internal friction of transmission system, type of road surface, tyre friction, etc.
- The value of rolling resistance depends on the loaded vehicle weight and is independent of vehicle speed.

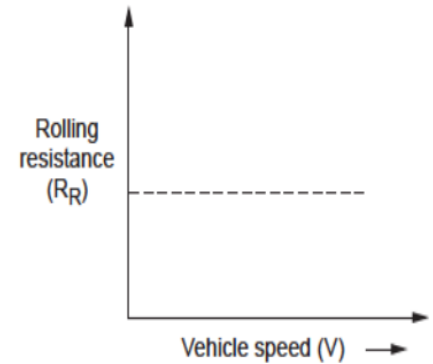
$$\text{Rolling resistance } (R_R) = \mu_{RR} \cdot W$$

Where, R_R = Rolling resistance

W = Vehicle weight

μ_{RR} = Co-efficient of rolling resistance

- **Draw bar pull** is a term defined as total tractive effort at road wheels minus the rolling resistance.



Rolling on miscellaneous resistance

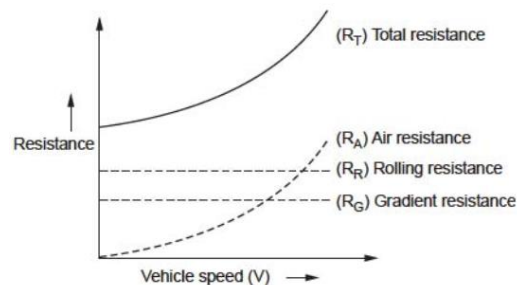
4. Total Resistance (R_T) to Vehicle Motion

Total Resistance (R_T) to vehicle motion :

- Refer Fig. for superimposition of all the three resistance to vehicle motion.

$$R_T = R_A + R_G + R_R$$



$$R_T = (\mu_{AR} \cdot A \cdot V^2) + \left(\frac{W}{G}\right) + (\mu_{RR} \cdot W)$$



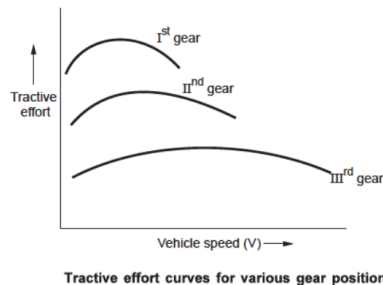
Various resistance to the vehicle motion

3. What is mean by traction and tractive force?

- There are various forces opposing the forward motion of the vehicle.

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- The driving force provided by the Engine is called as **“TRACTIVE EFFORT”**.
- It is define as the power / torque available at the road wheels developed by the engine and transmitted by transmission system.
- Varies as per gear ratio.
- Torque and increasing number of gears are inversely proportional, **i.e. Lower the gear Higher the torque**
- When the Total Resistance > Tractive Effort = **“Deceleration”**
When the Total Resistance < Tractive Effort = **“Acceleration”**
- The various resistance observed during the motions are



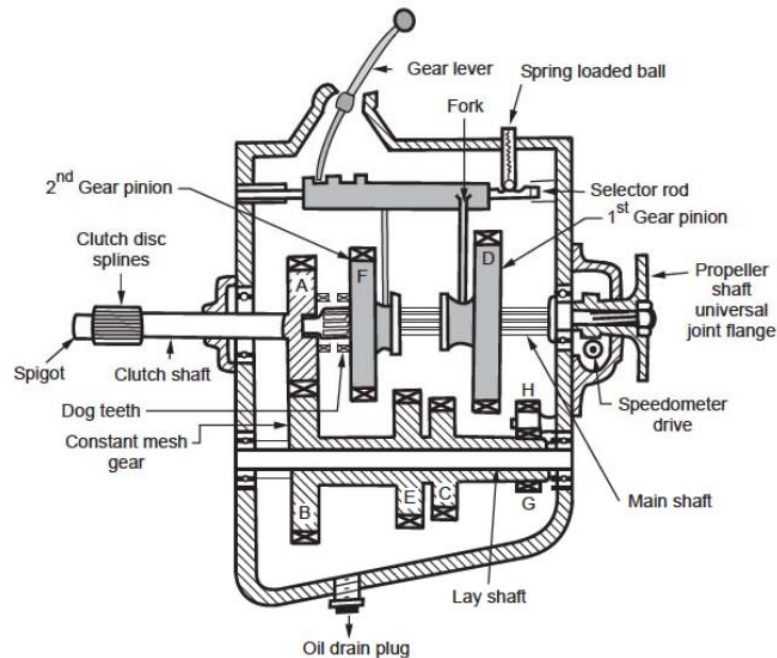
- Air or Wind Resistance**
- Gradient Resistance**
- Rolling or Miscellaneous Resistance**

4. What are the function and necessity with Construction and working details of gear box?



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- (a) The engine produces torque or tractive effort over a limited engine speed. But an automobile is driven under different conditions requiring large variation in torque at road wheels.
The main function of gearbox is to provide a mean to vary the torque ratio between the engine and the road wheels as and when required.
- (b) Gearbox also provides a mean to move the automobile backward with a reverse gear.
- (c) It also enables a neutral position for starting the engine and keep it running without transmitting drive to the road wheels.

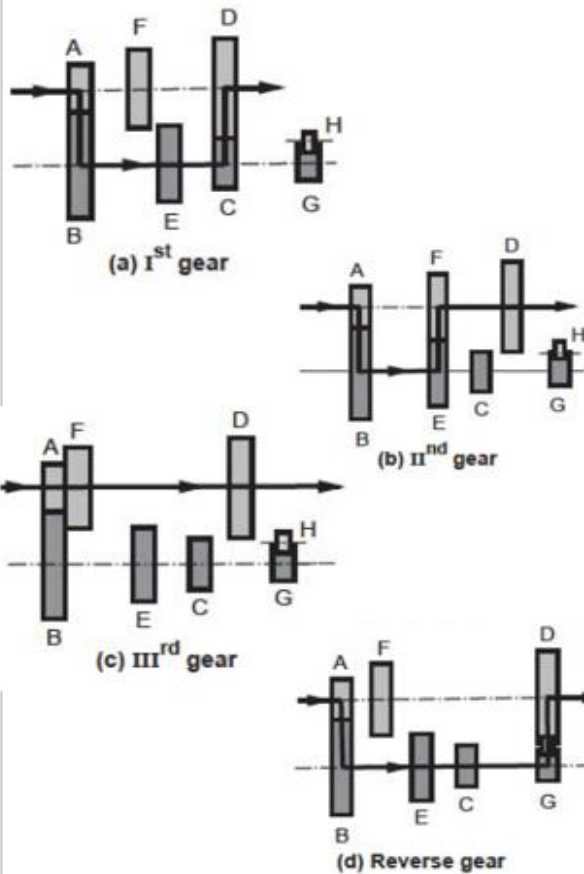


Sliding Mesh Type Gear Box

Working of Gear Box:-



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(i) Ist Gear

- To engage Ist gear, gear 'D' is shifted towards left such that it meshes with gear 'C'.
- Refer Fig. 2.9 (a) for power flow in Ist gear.

$$\text{Gear ratio } (G_1) = \frac{N_A}{N_D} = \frac{T_D \times T_B}{T_C \times T_A}$$

(ii) IInd Gear

- To engage the IInd gear, Ist gear is disengaged.
- Then gear 'F' is shifted to mesh with gear 'E'.
- Refer Fig. 2.9 (b) for power flow in IInd gear.

$$\text{Gear ratio } (G_2) = \frac{N_A}{N_F} = \frac{T_F \times T_B}{T_E \times T_A}$$

(iii) IIIrd Gear

- To engage the IIIrd gear, the sliding gear 'F' is shifted towards left such that its dog teeth meshes with dog teeth on gear 'A'.
- This is also called as direct drive.



- Refer Fig. 2.9 (c) for power flow in IIIrd gear.

$$\text{Gear ratio } (G_3) = N_A = N_F$$

(iv) Reverse Gear

- To engage the reverse gear all other gears are disengaged.
- The sliding gear 'D' is shifted towards right such that it meshes with reverse idler gear 'H'.

5. Differentiate sliding mesh, constant mesh, synchromesh gear boxes.

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Parameter	Sliding Mesh Gear Box	Constant Mesh Gear Box
Construction	It consists of spur gear	It consists of helical gear
	The main shaft gears are not in mesh constantly with the counter shaft gears, which can slide and mesh.	All the gears on the main shaft are in constant mesh with the corresponding gears on the counter shaft
	Selector fork unit is used in this gearbox for engaging the gear	Dog clutch unit is used in this gear box for engaging the gears
Torque Transmission	Low	High
Size	The size of the gearbox is large	The size of the gearbox is small as compare to sliding mesh gearbox.
Application	It is the oldest type of gearbox used in motor vehicles.	Constant mesh gearbox has been used in 2&3-wheelers.

Sliding Mesh Type Gear Box

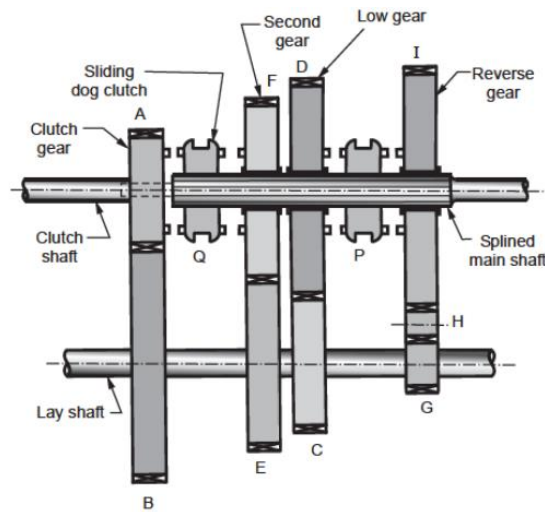
It is simplest type of gear box out of the available gear boxes. In this type of gear box, gears are changed by sliding one gear on the other. This gear box consists of three shafts; main shaft, clutch shaft and a counter shaft. In a four speed gear box (which includes one reverse gear), the counter shaft has four gears which are rigidly connected to it. Clutch shaft has one gear and main shaft has two gears. The two gears on the main shaft can slide in the horizontal direction along the splines of the main shaft. However, the gears on the counter shaft cannot slide. The clutch gear is rigidly fixed to the clutch shaft. It is always connected to the countershaft drive gear. The two gears on the main shaft can be slid by the shifter yoke by operating the shift lever (not shown in Figures). These two gears are second gear and low/reverse gear respectively. These gears can be meshed with corresponding gears on the countershaft with the help of shifter yoke and shift lever. Shift lever is operated by hand in four wheelers for changing the gears. A reverse idler gear is mounted on another (third) shaft and is always in mesh with reverse gear on countershaft.





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Constant Mesh Type Gear Box

A simplified diagram of constant mesh box has been shown in Figure 14.4. In this gear box, all gears on the main transmission shaft are constantly connected to corresponding gears on countershaft or lay shaft. In addition, two dog clutches are provided on the main shaft. One dog clutch is between the second gear and clutch gear and another is between the first gear and reverse gear. Splines are out on main shaft so that all the gears are feed on it



Dog clutches can also slide on main shaft and rotate with it. However, all the gears on countershaft are rigidly fixed to it. Different gear ratios (speed ratios) are obtained as follows : For Three Forward and One Reverse Gear Top or 3rd speed gear is obtained when the left dog clutch is slid to left to mesh with clutch gear by using the gear shift lever. In this case, main shaft rotates at the same speed as that of clutch gear or engine crankshaft speed which is the maximum speed. Speed ratio obtained is 1 : 1. Second gear is obtained when dog clutch (left side) meshes with second gear. In this condition clutch gear rotates the drive gear on countershaft and countershaft drives the second gear on the main shaft. All other gears on main shaft are free, so they do not move. In the same manner, first gear is obtained when right hand side dog clutch meshes with first gear. Reverse gear is obtained when right side dog clutch meshes with reverse gear on main shaft. Advantage of Constant Mesh Gear Box Since all the gears are in constant mesh, wear and tear of gears and any

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possible damage of gears do not occur in engaging and disengaging gears. Also, any sound are not generated in engaged/disengaged.

Synchromesh Gear Box

This type of gearbox is similar to the constant mesh type in that all the gears on the main shaft are in constant mesh with the corresponding gears on the layshaft. The gears on the layshaft are fixed to it while those on the main shaft are free to rotate on the same. Its working is also similar to the constant mesh type, but in the former, there is one definite improvement over the latter. This is the provision of a synchromesh device which avoids the necessity of double-declutching. The parts which ultimately are to be engaged are first brought into frictional contact which equalizes their speed, after which these may be engaged smoothly.

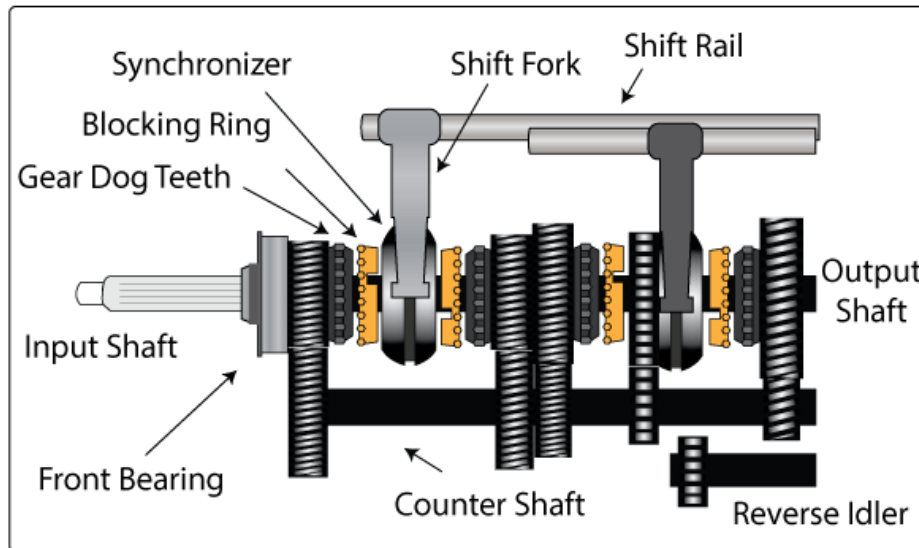
Reason of synchromesh gearbox preferred over constant mesh gearbox

- 1) No need of double-declutching as in case of constant mesh gearbox.
- 2) Smooth engagement of higher gears due to the synchromesh device.
- 3) Less noisy as helical gears are used.
- 4) Less vibration.

The figure shows the construction and working of a synchromesh gearbox. In most of the cars, however, the synchromesh devices are not fitted to all the gears as is shown in this figure. They are fitted only on the high gears and on the low and reverse gears ordinary dog clutches are only provided. This is done to reduce the cost.



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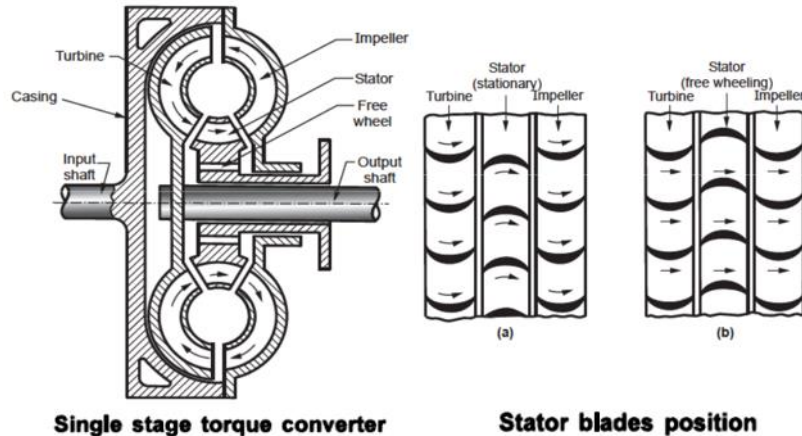
6. Write short note on torque convertor?

Torque Converter

- It is the form of coupling wherein fluid acts as the connecting link.
- Placed between crankshaft shaft and gearbox and replace the clutch.
- Commonly used in automatic transmission.
- It provides continuous variation in torque rather than step based finite torque variation .in general mechanism.
- Main components are
 - 1.Impeller
 - 2.Turbine
 - 3.Stator
 - 4.Fluid with Oil Pump



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A torque converter is a hydraulic fluid coupling that is used to transmit power from one or more engines or motors to a driveshaft or other output shaft. It takes the place of a mechanical clutch, and, within certain operating speed ranges, multiplies input torque, providing the equivalent of a reduction gear.

Uses : Torque converters are commonly found in automotive automatic transmissions, but are also used in marine propulsion systems and in various industrial machine tools.

Construction : A torque converter, like any fluid coupling, is a sealed chamber filled with hydraulic fluid (typically light oil) and containing a pump (or impeller) driven by the engine(s) and a turbine connected to an output shaft. The impeller is a toroid disc connected to the engine's crankshaft (or output shaft of the motor or other power source).

Stator torque multiplication

A torque converter differs from a simple fluid coupling by the addition of a stator, a disc with fan-like blades connected to the transmission via a fixed shaft with a one-way clutch that allows it to rotate only in the opposite direction of the fluid's radial motion. Without the stator, fluid leaving the turbine would strike the impeller with a radial motion opposite its rotation, causing a braking effect. With the stator, the returning fluid strikes the stator blades, which reverses the radial direction of the fluid's motion so that it is moving the same direction as the impeller when it reenters the impeller chambers. This reversal of direction greatly increases the efficiency of the impeller, and the force of the fluid striking the stator blades also exerts torque on the turbine

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output shaft, providing additional torque multiplication equivalent to a higher numerical gear ratio.

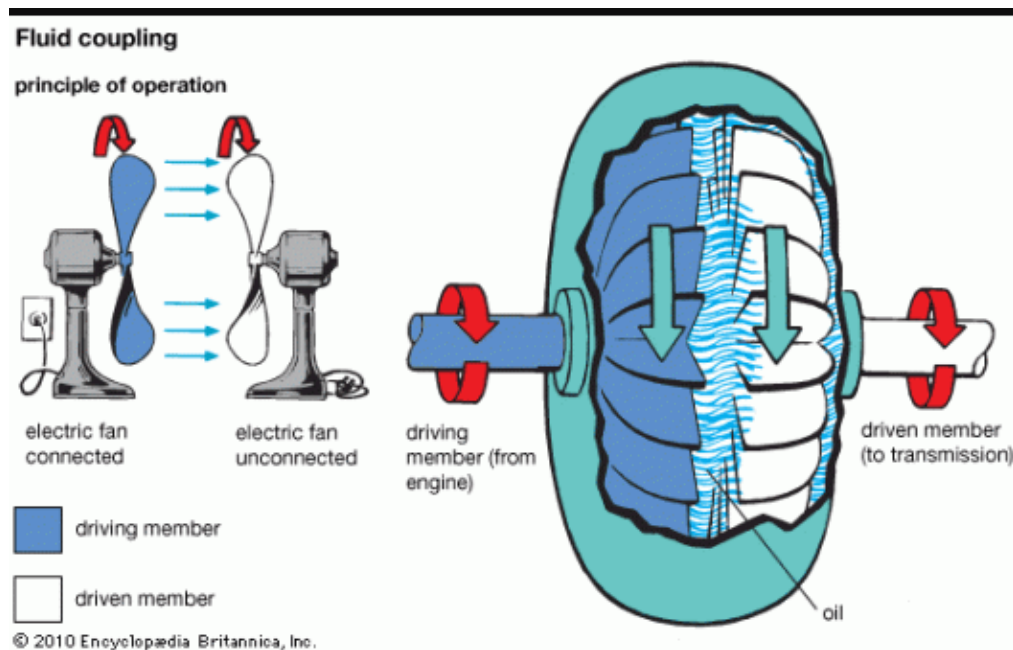
How it works?

When the engine or power source is operating it turns the impeller at the same speed. The rotation of the radial chambers on the inner surface of the pump imparts a centrifugal radial flow to the fluid in the converter, which causes hydraulic fluid to strike the outer edges of the turbine. The radial chambers on the surface of the turbine transmit the angular momentum of the fluid centripetally, reversing its direction and exerting a twisting force torque on the turbine disc that causes it to rotate in the same direction as the impeller. The fluid exits the center of the turbine and returns to the impeller to begin the cycle again. Because some of the kinetic energy imparted to the fluid is lost to friction (raising the temperature of the fluid rather than causing motion within it), the turbine always slips (rotates slower than the impeller), particularly at very low speeds. If the speed of the impeller is very low, such as at idle speed for an automobile engine, the torque exerted on the turbine output shaft will not be enough to overcome the shaft's inertia, allowing the shaft to remain stationary without stalling the engine and eliminating the need for de-clutching. As engine speed increases the speed of the impeller and the turbine become nearly the same (reaching their point of minimum slippage). Because the turbine is spinning faster than the fluid can exit its radial chambers, the net angular momentum of the exiting fluid is in the same direction as the turbine's rotation, rather than opposite it. As the impeller approaches this speed, the torque multiplication provided by the stator decreases. At that critical speed (the converter's stall speed) the fluid strikes the back of the stator blades, causing the stator to freewheel so that it will not interfere with the return flow of fluid. The maximum amount of torque multiplication provided by the stator depends on the angle and design of its blades. Typical torque multiplication ranges from 1.8 to 2.5:1 for most automotive applications, up to 5.0:1 or more for static industrial applications or heavy maritime propulsion systems. The blade angle and shape also affects the stall speed of the stator (although actual stall speed is also a function of the engine's input torque; an engine with less torque will stall the stator at lower rpm). While stator multiplication increases the torque delivered to the turbine output shaft, it also increases the slippage within the converter,



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raising the temperature of the fluid and reducing overall efficiency. For this reason, the characteristics of the torque converter must be matched to the torque curve of the power source and the intended application. For example, drag racing transmissions often use converters with high stall speeds to improve off-the-line torque because converter efficiency at cruising speeds is not significant. Some torque converters, such as certain versions of General Motors's TurboHydramatic, have a variable-pitch stator that can alter the angle of the stator blades between two or more positions depending on engine speed and throttle position, usually by means of a solenoid that moves the blades to a higher angle when engaged. Some torque converters use multiple stators and/or multiple turbines to provide a wider range of torque multiplication. Such multiple-element converters are more common in industrial applications than in automotive transmissions.

Advantages Despite the efficiency loss, moderate slippage of the coupling provides a smoother, more even flow of power by absorbing engine and powertrain vibration rather than allow it to be transmitted to the output shaft or surrounding equipment.



7. Write short note on universal joints.

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A universal joint is considered the oldest of all flexible couplings. It is commonly known for its application in automobiles and trucks. It is located where two shafts are to be joined at an angle to transmit torque. In the transmission system of a vehicle, the output shaft of the gearbox. The propeller shaft and the differential pinion shaft are not in one line, and hence the connection between them is made by a universal joint. Thus, it permits the torque transmission at an angle, and also while this angle is changing constantly while the vehicle is moving on the road. It is a simple and most common type of joint and is known as a **Cardan joint** or **hook joint**. They have a number of unique features that make them perfect for a range of applications.

Purpose of Universal Joint

When a car is running on an uneven road, the differential rises and falls. Thus, the propeller shaft also changes its angle due to the rise and fall of the differential at the same time the propeller shaft is rotating.

Under such conditions, these joint allows the changes of angle of the propeller shaft without the transmission.

If the differential is directly connected from the gearbox without a universal joint during the rise and fall of the [rear axle](#) the connection fails because it is not flexible due to the absence of a universal joint.



Parts of a Universal Joint

Following are the parts of a universal joint:

1. Driving yoke and driven yoke
2. Spider

1. Driving Yoke and Driven Yoke

The universal consists of two yokes, one is a driving yoke and another is a driven yoke, to form the joint.

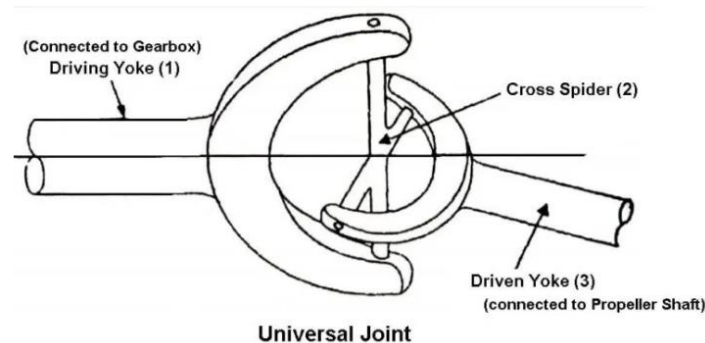
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2. Spider

These yokes are connected by means of a cross-shaped intermediate member called the spider. In this, a shaft can be rotated at many angles.

If the shaft is connected straight, the input shaft will rotate the cross, and the cross will turn the output shaft. It is obvious that both the input and output shafts will rotate at the same speed.

Working of Universal Joint



As per the above figure, it consists of a driving yoke '1' on one side. This is connected to the main shaft of the gearbox, and there is a driven yoke '3' is connected to the propeller shaft.



These two yokes are connected by means of a crossed spider '2'. The four arms of the spider are known as trunnions.

When the driving shaft is rotating the driven shaft also rotates, and at the same time, the universal joint allows angular motion. Hence the power is transmitted from the gearbox to the propeller shaft at an angle.

Thus, these joints are used to make a flexible connection between two rigid shafts at an angle with each other. They permit the transmission of the power not only at an angle but also while this angle is being varied constantly.

Functions of Universal Joint

The important functions of the universal joint are as follows:

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1. It is used to connect two shafts, whose axles intersect.
2. It permits the rotation of one shaft about its axis by another shaft which rotates about its own axis.
3. They permit the transmission of power not only at an angle, but also while this angle is being changing constantly.

Types of Universal Joint

Mainly there are 3 types of universal joints as follows:

1. Cross type or spider and two-yoke type joint
2. Ball and trunnion type joint
3. Constant velocity type joint

1. Cross-Type Universal Joint



In this joint, it has two Y-shaped yokes and a crosspiece (also known as a spider). One yoke is attached to the driving shaft and another one is attached to the driven shaft.

The cross piece consists of a four-arms (trunnion) that are connected to both ends of the yokes. Four bearings were also provided for each arm of the cross-piece. These bearings allow the yoke to move around the trunnion while simultaneously removing the driving and driven shafts at an angle.

2. Ball Trunnion Type Universal Joint

It is a combination of both universal and slip joints in one assembly. The ball trunnion type joint is consists of a ball-type head that are fastened to one end of the propeller or drive shaft.

A pin or cross shaft is pressed through this end of the shaft forming a 'T' shape. In this pin, two steel balls are fitted firmly. The joint helps in the rotational motion through the ball and the pin. The balls can also move axially in direction. Ball and trunnion joints are also variable velocity joints.

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3. Constant Velocity Type Universal Joint

It is a type of universal joint, which allows both driving and driven shafts to move at a constant velocity. Because, in this case, the two joints act on the same angle.

These joints are typically used when the vehicle is in a front-wheel (axle) drive. Because the speed variation between the driving and driven shaft will present difficulty in the steering system and results in excessive tire wear.

Advantages of Universal Joint

1. Universal joints have more elastic properties than knuckle joints.
2. These joints help in torque transmission between shafts that have an angular misalignment.
3. They are cheaper in cost and are simple to be assembled and dismantled.
4. The universal joint can provide high torque transmission efficiency.
5. These joints allow angular displacement compared to other types.

Disadvantages of Universal Joint

1. If the joint is not lubricated properly, it may wear out.
2. It requires frequent maintenance to avoid wear.
3. These joints can cause unstable motion.
4. They cannot support axial misalignment.



Applications of Universal Joint

Universal joints differ based on their material form and hub type. A positive mechanical joint is used to connect shafts. They are commonly seen in the propeller shafts of rear-wheel-drive cars.

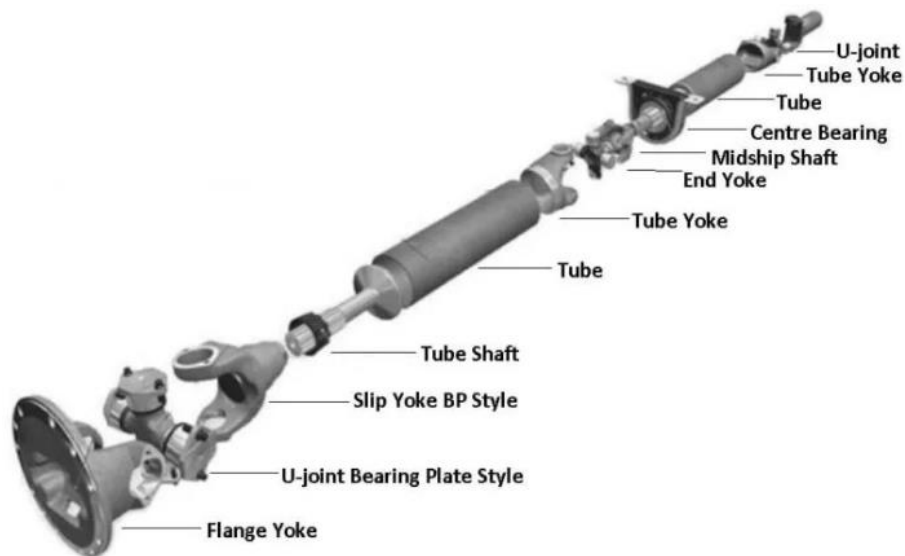
These are used for the purpose of transmitting motion, power, or both.

The joints with thermoplastic body members are used in light industrial applications because they offer advantages such as self-lubricating features, lightweight, negligible reactivity, corrosion resistance, and the ability to operate at high speeds.

These joints are commonly used in applications of aircraft, control mechanisms, electronics, instrumentation, medical and optical instruments, armaments, radios, sewing machines, textile machinery, and tool drives.



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Propeller Shaft



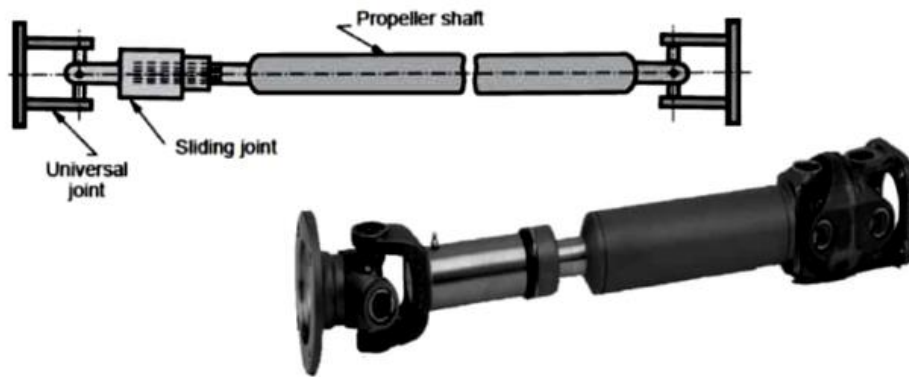
Parts of Propeller Shaft

- It is the driving shaft connected in between gearbox out put shaft and differential input shaft.
- The main function of propeller shaft is also to adjust the variation in angle between gearbox and differential.

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- It consist of 3 major component

1. Shaft 2. Universal Joint 3. Slip Joint



1. U-joint

A universal joint (U-joint) is a mechanical joint used to connect rotating shafts. Nowadays, the driveshaft and universal joints are mostly seen on rear-wheel drive and four-wheel drive vehicles.

2. Tube

A tube is a part of a drive shaft, It is often used in front engine and rear drive automobiles. The purpose of using a tube is to keep the rear end in place during acceleration and braking.

3. Centre Bearing



Centre bearing is used to connect the two sections of the drive shaft. These bearings are meant to keep both parts of the driveshaft solid to reduce harmonic vibrations when the vehicle is accelerating.

4. Midship Shaft

Midship shafts are the basic components of a coupling shaft and are part of a drive shaft that is attached to the frame on a center bearing.

5. End Yoke

An end yoke is used for accuracy and durability. The benefit of using an end yoke is to help reduce noise and vibration to keep your driveline running easily.

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6. Slip Yoke and Tube Yoke

A slip yoke is attached to the driveshaft itself using a universal joint. The slip yoke is fitted to transfer power by sliding in and out of the transfer case. The tube yoke is also necessary to allow the U-joints to rotate well with the drive shaft.

7. Flanges

Flanges are used for automotive purposes to connect the driveshaft to the transmission, transfer case, and differential. The flanges are also used to connect drive shafts to power take-offs, hydraulic pumps, and a variety of accessories.

Functions of the Propeller Shaft

In vehicles, the engine is at the front then the front wheels of the vehicle are being driven. Whereas in some vehicles the engine is at the rear then the rear wheels are driving. To do this, a small propeller shaft is used to drive each wheel.

With the help of flexible mountings or bearings, the engine and transmission units are attached to the frame of the vehicle. Whereas the rear axle along with the differential and wheels are attached to the vehicle frame by a suspension spring.



If we look at the above arrangement, the transmission output and input shaft in the rear axle housing are in different planes. This forces the propeller shaft that connects these two shafts to keep them inclined.

In addition, when the rear wheels meet unevenness in the road, the rear axle moves up and down, compressing and expanding in the suspension springs. As a result, the angle between the transmissions output shaft and the propeller shaft changes.

Also, the length occupied by the propeller shaft changes. This variation occurs due to the propeller shaft and rear axle rotating on arcs along with the points of their axes of rotation.

Material Used In Propeller Shaft

The propeller shaft is made of hardened steel in tabular form. The center bearing is mounted between the two propeller shafts. The propeller shaft is made of alloy steel. They are also available of spring steel material.

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Types of Propeller Shaft

Following are the types of the propeller shaft:

1. Single piece type
2. Two or three piece type

1. Single Piece type

This shaft is used in vehicles with a small distance between the engine and axle and in four-wheel-drive vehicles. Friction welding is applied in order to increase the strength, quality, and durability of the shaft.

2. Two or Three Piece type

Two or three-piece shafts are used as part of vehicles with a long distance between engine and axle, and four-wheel-drive vehicles. Splitting the propeller shaft into two or three parts reduces the number of revolutions.

Conditions of Propeller Shaft

In order to achieve efficient functions, the propeller shaft requires the following:

1. High torsional Strength
2. Toughened and hardened
3. Efficiently combined
4. Dynamically balanced
5. Low thrust load

8. What is differential and purpose of differential?

In automobiles, the differential is a gearing system that allows the outer wheel to rotate faster than the inner wheel when turning. This is essential when the vehicle turns, causing the wheel to move outside the turning curve to roll further and faster than the other.



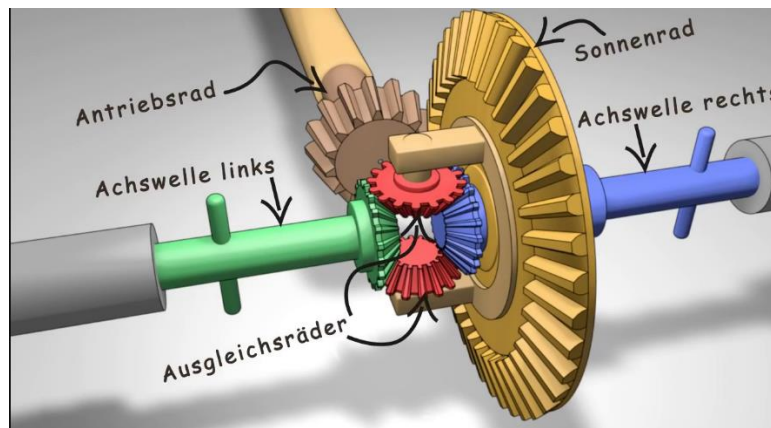
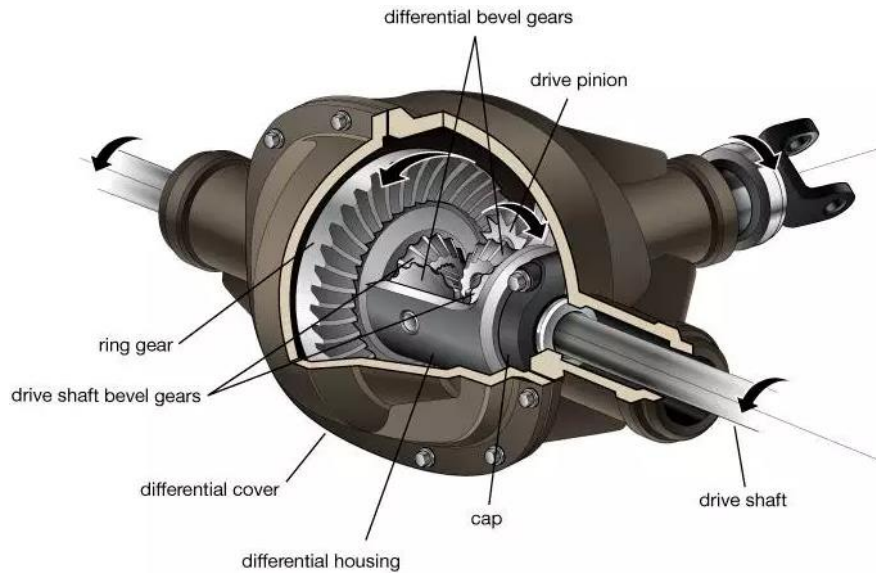
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Differentials are mainly used in automobile transmission*. Their main function is to make steering easier and improve the manoeuvrability of a vehicle. The differential transmits and divides the engine power and the torque** into two flows between the wheels on the same axle (as well as the tracks or propellers used in other vehicles). This allows wheels to rotate at different speeds making the vehicle more stable, without slipping, reducing tyre wear if one of the wheels has poor road adhesion. For example, when turning or driving on slippery surfaces.

Purposes of a Drive Axle Assembly

- To transmit power from the drive shaft to the wheels

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- To turn the power flow 90-degrees on RWD cars
- To allow the wheels to turn at different speeds while cornering
- The differential is a set of gears that transmits engine power to the wheels, while allowing them to turn at different speeds on turns. With front-wheel-drive (FWD), the differential is alongside the transmission inside a housing, and the unit is called a transaxle.
- As part of the front and/or rear axle assembly, the differential plays an integral role in how your car makes turns. The differential is designed to drive a pair of wheels while allowing them to rotate at different speeds. This function provides proportional RPMs between the left and right wheels.
- In case of all wheel drive cars, there are two differentials, one at the back and one for the front wheels. A transfer case is used to split power between front and rear wheels.
- Every car is different. The differential is a component in all cars and is designed to compensate for the difference in distance the inner wheels and outer wheels travel as the car goes around a corner.