



**Important Instructions to examiners:**

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

<b>Q 1 A</b> a)	<b>What is Clutch? State functions and classification of Friction Clutches.</b>
	<p>Clutch is a device used in transmission system of a vehicle to engage and disengage the engine to the transmission. Thus the clutch is located in between engine and transmission (gear box).</p> <p><b>Function of Clutch:</b></p> <p>[1] To permit engagement or disengagement of a gear when the vehicle is stationary and the engine is running.</p> <p>[2] To transmit the engine power to the road wheels smoothly without shock to the transmission system while setting the vehicle in motion.</p> <p>[3] To permit the engaging of the gears when the vehicle is in motion without damaging the gear wheels.</p> <p>[4] To allow the engine to take up load gradually without shock or jerk.</p> <p><b>Classification of Friction Clutches:</b></p> <p><b>Disc (Plate) Type Clutch</b></p> <p><b>[1] Single Plate Clutch</b></p> <p>1.1.1 Coil Spring Type Single Plate Clutch</p> <p>1.1.2 Diaphragm Spring Type Single Plate Clutch</p> <p><b>[2] Multiplate Clutch</b></p> <p>2.1.1 Dry Type Multiplate Clutch</p>



	<p>2.1.2 Wet Type Multiplate Clutch</p> <p><b>[3] Cone Clutch</b></p> <p><b>(2 Marks for Function, 2 Marks for Classification)</b></p>
b)	<p><b>State classification of automobile. List out any four manufactures of automobiles in India.</b></p>
	<p><b>[1] According to Purpose (Use)</b></p> <p>1.1.1 Passenger Cars</p> <p>1.1.2 Goods Carriage</p> <p>1.1.3 Special Purpose</p> <p>1.1.4 Earth Moving</p> <p>1.1.5 Motor Cycle (Bikes)</p> <p>1.1.6 Mopeds</p> <p><b>[2] According to Fuel Used:</b></p> <p>2.1.1 Petrol Vehicles</p> <p>2.1.2 Diesel Vehicles</p> <p>2.1.3 LPG/CNG Vehicles</p> <p>2.1.4 Electric Cars</p> <p>2.1.5 Hybrid Cars</p> <p>2.1.6 Solar Cars</p> <p>2.1.7 Fuel Cell</p> <p><b>[3] According to Load Carrying Capacity:</b></p> <p>3.1.1 Heavy Motor Vehicle</p> <p>3.1.2 Medium Motor Vehicle</p> <p>3.1.3 Light Motor Vehicle</p> <p><b>[4] According to Drive Used:</b></p> <p>4.1.1 Left and Right Hand Drive</p>



4.1.2 Two Wheel and Four Wheel Drive

**[5] According to Engine Location and Mounting:**

5.1.1 Front Engine Front Wheel Drive

5.1.2 Rear Engine Rear Wheel Drive

5.1.3 Front Engine Rear Wheel Drive

5.1.4 Bus Chassis

5.1.5 Full Forward Chassis

5.1.6 Semi Forward Chassis

**[6] According to Body Styles:**

**A. Passenger Cars:**

6.1.1 Sedan/Saloon

6.1.2 Hardtop

6.1.3 Lift back (Hatchback)

6.1.4 Station Wagon

6.1.5 Coupe

6.1.6 Limousine

6.1.7 Convertible

6.1.8 Estate Car

**B. Heavy Vehicles/Trucks:**

6.1.1 Truck Punjab Body

6.1.2 Truck Half Body

6.1.3 Truck Platform Type

6.1.4 Truck with Trailer

6.1.5 Dumper

6.1.7 Tanker

**[7] According to Wheel and Axle:**



7.1.1 Two and Three Wheeler

7.1.2 Four Wheeler and Six Wheeler

7.1.3 Single and Multi Axle (Enlist any 4 of the above mentioned each of ½ Marks)

**Manufactures of Automobile in India:**

S.No.	Manufacturers	Categories/Product
1	Ashok Leyland	LMV, HCV
2	Asia Motor Works	MMV & HCV
3	Baja Auto	Two and Three Wheelers
4	Mahindra and Mahindra	Cars, MUV's, LCV, 2 & 3 Wheelers
5	Maruti-Suzuki India	Cars, MUV's
6	TATA Motors	Cars, MUV, LCV, HCV
7	Kinetic Engineering	2 Wheelers
8	Hero MotoCorp	2 Wheelers
9	Fiat India	Cars
10	Force Motors	MUV, LCV, 3 Wheelers
11	Premier Ltd.	SUV

(Enlist any Four of the above mentioned each of ½ Marks)

(2 Marks for Classification, 2 Marks for List of Manufactures)

c) **Justify aerodynamic shape of body.**

**Necessity of Aerodynamic Shape of Body:**

[1] Due to the increasing demand of efficient and comfortable cars, Automobile Aerodynamics is an important element in improving the overall performance of Vehicle.

[2] Air resistance opposes the forward motion of the car. It influences fuel consumption and attainable maximum speed of vehicle.

[3] Hence it is the design engineer's task to make the drag coefficient of vehicle as small as possible by shaping the body aerodynamically.

**Advantages of Aerodynamic Shape of Body:**



	<p>[1] Reduce Air resistance or air drag.</p> <p>[2] Reduce driver effort to drive vehicle.</p> <p>[3] Improve speed of vehicle.</p> <p>[4] Provide better fuel economy through reducing fuel consumption.</p> <p>[5] Provide attractive shapes and better aesthetic appearance to the vehicle.</p> <p>[6] Reduce noise pollution.</p> <p>[7] Reduce running cost of vehicle.</p> <p>(4 Marks for correct description, including importance, advantages etc.)</p>
d)	<p><b>Define following terms: i) Camber ii) Caster iii) Toe in iv) King pin Inclination</b></p>
	<p>[1] <b>Camber:</b> It is the tilt of car wheels from the vertical. Camber is <b>positive</b>, if the tilt is outward at the top. Camber is <b>negative</b>, if the tilt is inward at the top</p> <p>[2] <b>Caster:</b> It is the angle between king pin centre line and the vertical, in plane of wheel. If king pin center line meets the ground at a point in front of wheel centre line it is called <b>Positive Caster</b>. If it is behind the wheel centre line, it is called <b>Negative Caster</b>.</p> <p>[3] <b>Toe in:</b> When the front wheels of the vehicle are pointing inward, they are said to toe in.</p> <p>[4] <b>King Pin Inclination:</b> Inclination of king pin from vertical is called the king pin inclination.</p> <p>(1 Mark for each correct definition)</p>
1 B a)	<p><b>Draw a layout of hybrid vehicle and explain its working. State its advantages.</b></p>
	<p><b>Layout of Hybrid Vehicle:</b></p> <p>The diagram illustrates the energy flow in a hybrid vehicle. It features four main components in boxes: 'High Voltage' (green), 'DC - DC' (red), 'Inverter' (blue), and 'Motor' (orange). Bidirectional arrows connect 'High Voltage' to 'DC - DC', 'DC - DC' to 'Inverter', and 'Inverter' to 'Motor'. A red arrow labeled 'Electric Drive Mode' points from left to right above the components. A blue arrow labeled 'Regenerative' points from right to left below the components.</p>



Generally, a vehicle which can utilize more than one energy sources for propulsion, it is called as Hybrid Vehicle. So the combination of petrol Engine & LPG, Diesel Engine & CNG, or Petrol and Battery operated vehicle are the examples of Hybrid vehicles.

**Working of Hybrid Vehicle:**

When the driven steps on the pedal the generator convert energy from the engine into electricity and store it in the battery. The battery then provides power to the electric motor. The internal combustion engine and electric motor works simultaneously and each provides power to the power split device. The power split device combines both powers and uses it to the transmission. The transmission then turns the wheel and propels the vehicle.

**Advantages of Hybrid Vehicle:**

- [1] It converts 40 % of the energy stored in petrol to power the vehicle.
- [2] It provides moderate speed range (110 mph).
- [3] Energy Efficient.
- [4] Environment Friendly.
- [5] Zero Emission.
- [6] Reduce Noise.

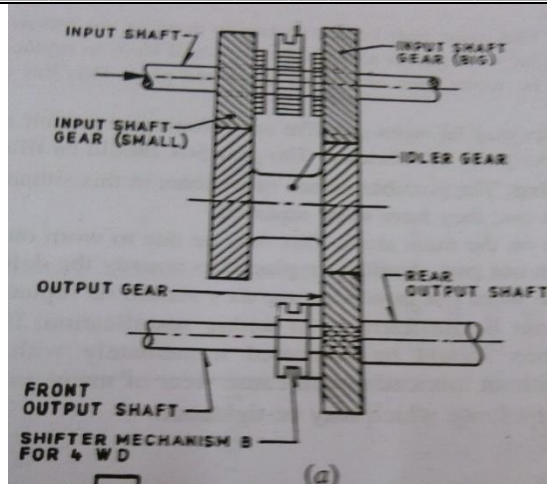
**(2 Mark for Block Diagram, 2 Mark for Working, 2 Marks for Advantages)**

b) **Explain the working of transfer case with neat diagram and give its application.**

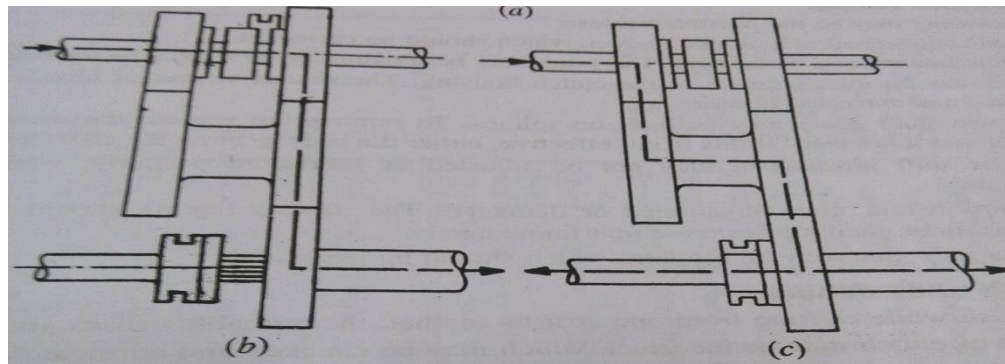
**Working of Transfer Case:**

Transfer Case is the device used in all wheel drive vehicle, that splits the power between the front and rear axles on a four-wheel-drive car. While the differentials handle the speed difference between the inside and outside wheels, the transfer case in an all-wheel-drive system contains a device that allows for a speed difference between the front and rear wheels

When the shifter mechanism *A* is at the centre so that no gear is connected to the input shaft, the drive is in neutral as shown Fig. (*a*). Fig (*b*) shows a position when the shifter mechanism *A* connects the input shaft with the big input gear, but the shifter mechanism *B* disconnects the front output shaft from the rear output shaft. In this position, two-wheel drive with the high gear is obtained.



**Figure (a): Neutral Position of Transfer Case**



**Figure (b): 2 WD in High Gear    Figure (c): 4 WD in Low Gear**

In the same way Fig. (c) depicts the situation with four wheel drive in low gear. Obviously, four-wheel drive with low gear should be used invariably with the low gears on the main transmission. Also, the transfer box gears should be engaged with the vehicle stationary since these are not provided with synchromesh devices.

**Application of Transfer Case:**

Transfer Case (Gear Box) is an essential element of Four (All) Wheel drive vehicle.

- [1] Mahindra Jeep
- [2] Maruti Gypsy
- [3] Shaktiman Truck (Military Vehicle)

**( 2 Marks for neat labeled sketch, 3 Marks for Working, 1 Mark for Application)**



Q 2 a) **Differentiate between conventional and unitary body.**

**Difference between Conventional and Unitary Body:**

S.No.	Conventional Body	Unitary Body
1	There are two heavy side members and cross members welded, bolted or riveted to the superstructure.	In this, heavy cross and side members are eliminated. Thick metal sheet is directly welded to the floor pan of vehicle.
2	Heavier in construction	Light in weight
3	Ground clearance is more	Ground clearance is less
4	Higher centre of gravity	Lower centre of gravity
5	Due to use of nut & bolts, it's having noisy operation.	There are no bolts or nuts to loosen
6	Maintenance is easier	In case of accident, difficult to maintain
7	Less wear and corrosion	More wear and corrosion
8	Production cost is more	Production cost is less, if manufacturing in mass quantity
9	Used in heavy vehicles like trucks & buses	Used in light vehicles like passenger cars

( Enlist any Four Points from the above mentioned, 1 mark for each point)

b) **Enumerate the various resistances that have to be overcome by an automobile moving on the road.**

**Resistance offered by moving Vehicle:**

**[1] Air or Wind Resistance ( $R_a$ ):**

It is the resistance offered by air to the movement of a vehicle. It depends upon the size and shape of vehicle as well as upon its speed and wind velocity.

$$R_a = K_a \cdot A \cdot V^2$$

Where,

$K_a$  = Coefficient of Air Resistance

A = Projected Frontal Area of Vehicle

V = Speed of Vehicle





**[2] Gradient Resistance ( $R_g$ ):**

It is the force opposing forward motion of a vehicle up a gradient. In case of a motor vehicle moving up a gradient, the component of the weight parallel to the surface affects the movement of the vehicle upward on the gradient. It is depend on the steepness of the grade.

$$R_g = W \cdot \sin\theta$$

Where,

$W$  = Weight of Vehicle

$\theta$  = Gradient

**[3] Rolling Resistance ( $R_r$ ):**

it is the force necessary to maintain constant speed on a level road. This resistance is based upon the deformation or nature of the road surface and nature of the tyre as well as dissipation of energy through impact and the total weight of the vehicle along with load in it.

$$R_r = K_r \cdot W$$

Where,

$K_r$  = Coefficient of Rolling Resistance

$W$  = Weight of the Vehicle

**(3 Marks for Definition, 1 Mark for Equation)**

c) **Compare between hydraulic braking systems with pneumatic braking system.**

**Difference between Hydraulic and Pneumatic Braking System:**

S N	Hydraulic Braking System	Pneumatic Braking System
1	Braking Fluid used as a working medium	Compressed air is used as a working medium
2	Simple in construction	Robust (Heavy) in construction
3	Occupied less space as compared to Air brake	Occupied more space as compared to Hydraulic brake
4	System is self lubricating	Need to lubricate mechanical parts
5	Bleeding is necessary	No need of bleeding
6	Increased braking effort, but less powerful than air brakes.	Most powerful than Hydraulic brake

7	Low maintenance cost.	Maintenance cost is more
8	Mostly used in passenger cars, LCVs.	Exclusively used in heavy vehicles like bus & truck

(Enlist any four points from the above mentioned, 1 Mark for each point)

d) Describe with sketch air conditioning system of an automobile.

**Air Conditioning System in an Automobile:**

[1] **Compressor:** The compressor is belt driven from the crankshaft. An electric clutch engages and disengages the compressor pulley from the shaft. The compressor receives R134 in gaseous form at the inlet and pressurizes the refrigerant to a high pressure. This pressure from the compressor causes the R134 to move through the air conditioning (A/C) system. It draws off gaseous refrigerant from the evaporator and compresses it. This causes the refrigerant gas temperature and pressure to rise rapidly.

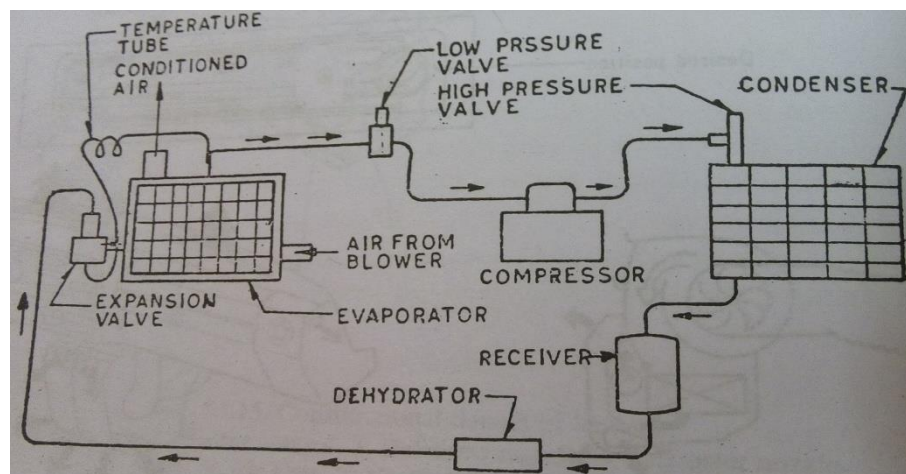
[2] **Condenser:** Through which the heated refrigerant gas gives off heat to the engine cooling air. The refrigerant gas cools off and once again becomes liquid.

[3] **Receiver:** It removes any traces of moisture and filters out dirt's in the system. It also serves as a reservoir for excessive refrigerant.

[4] **Expansion Valve:** It controls the liquid refrigerant into this evaporator core, causing a drop in pressure and consequently drops in temperature.

[5] **Evaporator:** In which the released refrigerant expands and flows through the evaporator tubes. This removes heat from the air blowing across the fins and tubes and evaporates, causing the temperature inside the vehicle gradually to be lowered.

[6] **Dryer:** The main purpose of dryer is to trap the moisture that may enter in the system during original assembly or charging. Moisture is an enemy of air conditioning system because it can react with the refrigerant and corrode the inside of the system.



**Figure: Schematic Layout of Automobile Air Conditioning System**



	<b>(2 Marks for neat labeled sketch, 2 Marks for Description)</b>																						
e)	<b>Why air conditioning is necessary in an automobile?</b>																						
	<p><b>Necessity of Air Conditioning in an Automobile:</b></p> <p>[1] During cold weather, a vehicle without a heater could become unfortunately, even dangerously, cold.</p> <p>[2] The vehicle could get unfortunately hot for a variety of reasons.</p> <p>[3] A vehicle may collect heat from any of the following sources;</p> <p style="padding-left: 40px;">(a) Heat from sun which radiates through the roof and windows</p> <p style="padding-left: 40px;">(b) Engine heat transmitted through the dash panel</p> <p style="padding-left: 40px;">(c) Heat from exhaust system</p> <p style="padding-left: 40px;">(d) Heat from hot pavement conducted through floor panels</p> <p style="padding-left: 40px;">(e) Heat radiated by passengers</p> <p>[4] These heat sources combine to increase temperature of passenger compartment and cause mild to extreme discomfort.</p> <p>[5] Thus the main purpose of the automobile climate control (Air Conditioning) systems is to provide passenger comfort.</p> <p>[6] Climate control (Air Conditioning) systems perform this function by circulating and cooling or warming the air in the vehicle passenger compartment to control the temperature and lower the humidity.</p> <p><b>( Enlist any 4 points , 1 Mark for each)</b></p>																						
Q 3 a)	<b>Differentiate between Disc and Drum brake.</b>																						
	<b>Difference between Drum and Disc Brake:</b>																						
	<table border="1"> <thead> <tr> <th>S.N</th> <th>Drum Brake</th> <th>Disc Brake</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Friction occurs on the internal surfaces so it not exposed to the cooling air directly.</td> <td>Friction surface is directly exposed to the cooling air</td> </tr> <tr> <td>2</td> <td>Friction linings are curved.</td> <td>Friction pads are flat</td> </tr> <tr> <td>3</td> <td>Loss of efficiency due to expansion</td> <td>No loss of efficiency due to expansion</td> </tr> <tr> <td>4</td> <td>More weight.</td> <td>Less weight</td> </tr> <tr> <td>5</td> <td>More Pedal load required to apply brake</td> <td>Less Pedal load required to apply brake</td> </tr> <tr> <td>6</td> <td>More coefficient of friction.</td> <td>Less Coefficient of friction.</td> </tr> </tbody> </table>	S.N	Drum Brake	Disc Brake	1	Friction occurs on the internal surfaces so it not exposed to the cooling air directly.	Friction surface is directly exposed to the cooling air	2	Friction linings are curved.	Friction pads are flat	3	Loss of efficiency due to expansion	No loss of efficiency due to expansion	4	More weight.	Less weight	5	More Pedal load required to apply brake	Less Pedal load required to apply brake	6	More coefficient of friction.	Less Coefficient of friction.	
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7	Complicated in design.	Simple in design
8	Replacement of brake lining is difficult as it requires riveting or fixed with adhesives	Replacement of friction pad is easy.

(Enlist any 8 points, 1 mark for each)

b) **Describe construction and working of Hooke's type universal joint and slip joint. Also state their necessary.**

**Purpose of Universal Joint:**

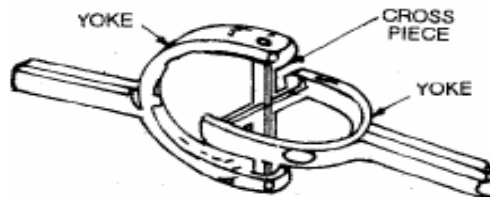
A universal joint is a particular type of connection between two shafts, whose axes are inclined to each other. A universal joint is used where two shafts are connected at an angle to transmit the torque. The purpose of the universal joint is to absorb the angular changes brought about changes in relative positions of the differential in relation to the transmission and in this way to smoothly transmit power from the transmission to the differential.

**Construction & Working of Hooke's Type Universal Joint:**

The simplest type of U joint is the Hooke's joint. It is most widely used because of the fact that it is simple and compact in construction and reasonably efficient at small angles of propeller shaft movement up & down, says upto 18°. The axis of shaft is intersecting. It consists of three main members as shown in figure;

1. Driving Yoke
2. Driven Yoke
3. Cross or Spider

Each of the shafts contains a yoke. Driving shaft connected to the driving yoke and driven shaft connected to the driven yoke. The cross has four arms called as trunions. The two opposite arm of the cross are supported in bushes in the yoke of shaft, while the other two arms of the cross are supported in the yoke of shaft.



**Figure: Hooke's Joint**

**Purpose of Sliding (Slip) Joint:**

The propeller shaft is connected between the transmission main shaft and the differential pinion shaft. The differential with rear axle housing and wheel moves up and down. This not only changes the angle of drive but also changes the length of the propeller shaft. The U joint permits the variation in the angle of drive.

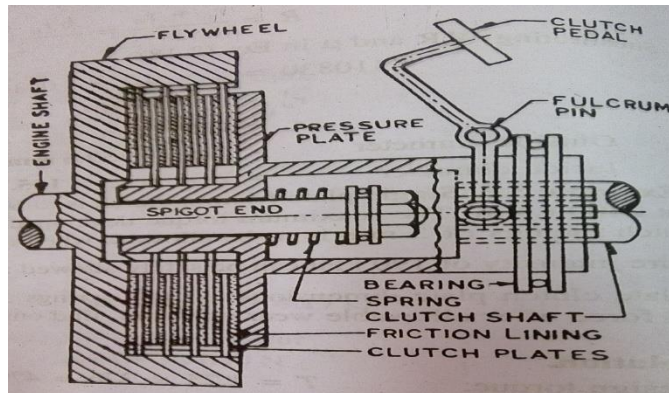
The slip joint permits the effective length of the propeller shaft to change. If there is no slip joint the propeller shaft would buckle or break.

**(2 Marks for Purpose of U Joint, 2 Marks for Purpose of Slip Joint, 2 Marks for Construction of Hooke's Joint, 2 Marks for Neat Sketch)**

c) **Describe the working of Multiplate dry clutch with diagram. State its applications.**

**Multi Plate (Dry) Clutch:**

It is the extension of single plate clutch. It consists of a number of clutch (friction) as well as pressure plates. As the number of plates increased, the friction surfaces also increase. The increase in number of friction surfaces obviously increases the capacity of the clutch to transmit torque. The plates are alternately fitted to the engine shaft and gear box shaft. They are firmly pressed by strong coil springs and assembled in a cover assembly. Each alternate plate has inner and outer splines, this each of the alternate plate slides on the splines on pressure plate.



**Figure: Multi Plate (Dry) Clutch**

**Working of Multi Plate Clutch:**

The pressure plates are used to apply the pressure on friction plates and the inside diameter of the pressure plate is splined while making the inside diameter splined, the rotating motion of pressure plate is restricted. The pressure plate moves on the driven shaft axially. When we apply the pedal the pressure plates and the friction plates come in contact with each other and the speed or power is transmitted from the engine shaft to the transmission shaft.

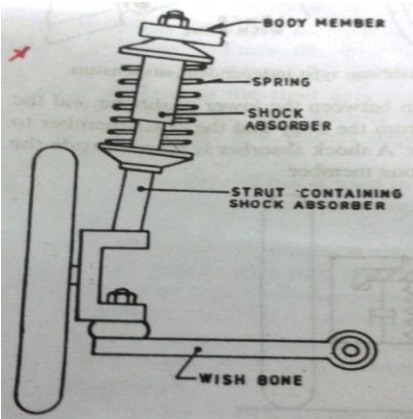
**Applications:**

This type of clutch is used in **Scooters and Motor Cycles**, where space availability is limited. Besides, this finds the application in some **Heavy Transport Vehicles** and **Racing Cars** where high torque is to be transmitted.

**(3 Marks for Neat labeled Sketch, 3 Marks for Working, 2 Marks for Applications)**



Q 4 a)	<b>State the function of suspension system and classify suspension system.</b>
	<p>Function of Suspension System:</p> <ul style="list-style-type: none"><li>[1] To prevent the road shocks from being transmitted to the vehicle frame.</li><li>[2] To preserve the stability of the vehicle in pitching, rolling while in motion.</li><li>[3] To safeguard the occupants from road shocks.</li><li>[4] To maintain proper steering geometry.</li></ul> <p><b>Classification of Suspension System:</b></p> <p><b>[1] Suspension Spring:</b></p> <p><b>Conventional Suspension System:</b></p> <p><b>1.1.1 Metallic Spring</b></p> <ul style="list-style-type: none"><li>1.1.1.1 Leaf Spring</li><li>1.1.1.2 Coil Spring</li><li>1.1.1.3 Torsion Bar</li></ul> <p><b>1.1.2 Non Metallic Spring:</b></p> <ul style="list-style-type: none"><li>1.1.2.1 Rubber Spring</li><li>1.1.2.2 Air Spring</li></ul> <p><b>Independent Suspension System:</b></p> <p><b>1.1.1 Front Axle Independent Suspension System</b></p> <ul style="list-style-type: none"><li>1.1.1.1 Wishbone Type</li><li>1.1.1.2 Mac Pherson Strut Type</li><li>1.1.1.3 Vertical Guide Type</li><li>1.1.1.4 Trailing Link Type</li><li>1.1.1.5 Swinging Half Axle Type</li></ul> <p><b>1.1.2 Rear Axle Independent Suspension System</b></p> <ul style="list-style-type: none"><li>1.1.2.1 De Dion Axle Type</li><li>1.1.2.2 Trailing Link Type</li><li>1.1.2.3 Link Trailing Arm Type</li></ul> <p><b>[2] Shock Absorber:</b></p> <ul style="list-style-type: none"><li>2.1.1 Single &amp; Double Acting</li><li>2.1.2 Twin &amp; Mono Tube</li><li>2.1.3 Hydraulic &amp; Gas Filled (2 Marks for Function, 2 Marks for Classification)</li></ul>

b)	<b>Describe the working of Mac-Pherson strut type suspension with neat sketch.</b>
	<p><b>Working of Mc-Pherson type Suspension System:</b></p> <p>The Mc-Pherson suspension system is most widely used layout for Front wheel drive vehicle.</p> <ol style="list-style-type: none"><li>1. In this type of suspension only lower wishbone is used.</li><li>2. A strut containing shock absorber and the spring carries also the stub axle on which the wheel is mounted.</li><li>3. The wishbone is hinged with cross member and positions the wheel.</li><li>4. With this type of suspension camber also does not change when the wheel moves up and down.</li></ol>  <p style="text-align: center;"><b>Figure: Mc-Pherson Type Suspension System</b></p> <p>(2 Marks for Working, 2 Marks for labeled diagram)</p>
c)	<b>Draw a typical wiring diagram of automobile and label it.</b>

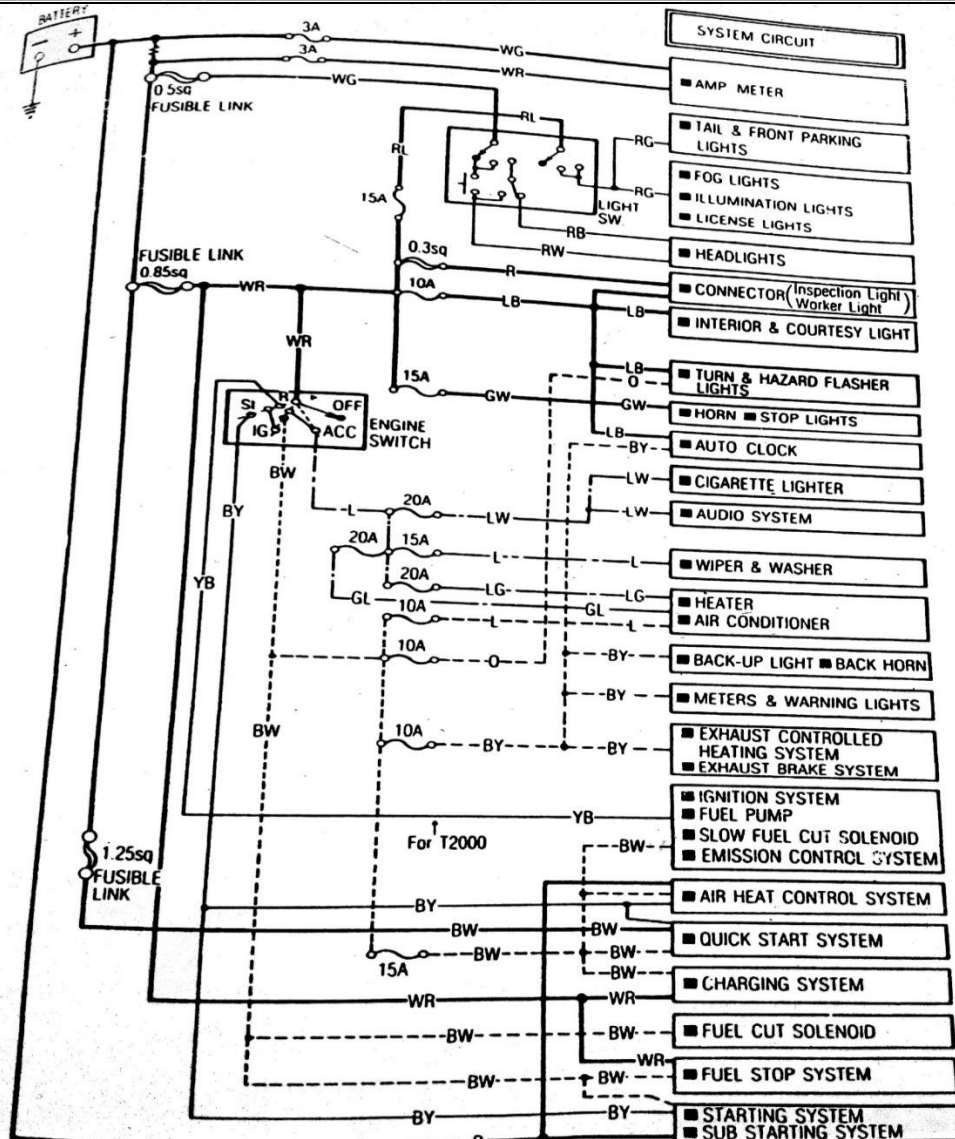


Figure: Typical Wiring Diagram of Automobile

( 3 Marks for neat Sketch, 1 Mark for labeling)

d) Why wheel alignment and wheel balancing is necessary?

**Necessity of Wheel Alignment:**

- [1] To eliminate tyre wear
- [2] To give vehicle proper handling
- [3] To eliminate pull, drift, wander, stiff steering and poor steering return ability
- [4] To improve driving stability
- [5] To improve riding characteristics





	<p><b>Necessity of Wheel Balancing:</b></p> <p>[1] Wheel imbalances causes wheel tramp, wheel hop, makes the tier vibrate up and down.</p> <p>[2] Centrifugal forces try to throw heavy areas outward when the wheel is spinning.</p> <p>[3] Weight must be evenly distributed around the axis of rotation.</p> <p>[4] Thus wheel balancing is necessary to balance the wheel and distributed the weight of wheel evenly.</p> <p><b>(2 Marks for each)</b></p>
4 B a)	<p><b>State the need of steering system. Enlist various steering systems available in market.</b></p>
	<p><b>Necessity of Steering System:</b></p> <p>The steering of a four wheeled vehicle is as far as possible, arranged so that the front wheels will roll truly without any lateral slip.</p> <p>[1] To control of front wheel (sometimes rear wheel) direction.</p> <p>[2] To maintain correct amount of effort needed to turn the wheels.</p> <p>[3] To transmit road feel (slight steering wheel pull caused by the road surface) to the driver's hand.</p> <p>[4] To absorb most of shock going to the steering wheel as the tire hits holes and bumps in the road.</p> <p>[5] To allow for suspension action.</p> <p><b>Types of Steering Systems available in Market:</b></p> <p>[1] Worm &amp; Wheel Type</p> <p>[2] Pack &amp; Pinion Type</p> <p>[3] Recirculating Ball Type</p> <p>[4] Cam &amp; Double Steering Gear Type</p> <p>[5] Worm &amp; Nut Type</p> <p>[6] Power Steering</p> <p>6.1. 1 Integral Type Power Steering</p> <p>6.1.2 Linkage Type Power Steering</p> <p><b>(3 Marks for Necessity, 3 Marks for Types)</b></p>
b)	<p><b>Now a day's power steering is used on most of vehicle. Why? State its advantages.</b></p>
	<p><b>Importance of Power Steering:</b></p>



- [1] Larger amount of torque is required to be applied by the driver for steering of medium and heavy vehicles.
- [2] The power steering system provides automatic hydraulic assistance to the turning effort applied to the manual steering system.
- [3] When the vehicle has to take a sharp turn, power steering makes it easier to turn sharp corners.
- [4] The power steering is designed to become operative when the effort at wheel exceeds a predetermined value of 10 N.
- [5] It is work on principle by fluid under pressure. The fluid usually used are oils of viscosity rating SAE 5W or SAE 10W or higher depending upon the atmospheric conditions.
- [6] The system operates under fairly high pressure which may be as much as 7 MPa.
- [7] The slight movement of the steering wheel actuates a valve so that the fluid under pressure from the reservoir enters on the appropriate side of cylinder, thereby applying pressure on one side of piston to operate the steering linkage, which steers the wheel in the appropriate direction.

**Advantages of Power Steering:**

- [1] The driver's effort is reduced.
- [2] When the vehicle suddenly meets a bump there is no coming back of steering wheel so that the driver can easily control the vehicle.
- [3] Even if power system fails, the vehicle can be steered easily by the help of manual steer.
- [4] It is useful for driving on rough roads at low speeds and while reversing the vehicle for parking purpose.

**(3 Marks for Importance, 3 Marks for Advantages)**

Q 5 a) **Describe construction of lead acid battery with sketch.**

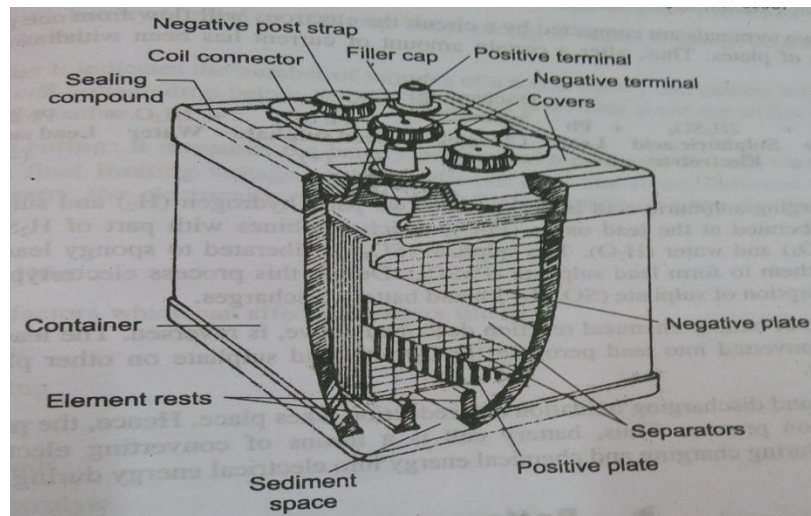
**Construction of Lead Acid Battery:**

A car battery is built to withstand sever vibration, cold weather, engine heat, corrosive chemicals, high current discharge and prolonged periods without use.

S. No.	Name of Components	Function
1	<b>Plates</b>	The battery plates are made of grid. The chemically active material in the negative plates is sponge (porous) lead. The active material on the positive plate is lead peroxide.



2	<b>Straps or Connectors</b>	Lead Battery straps or connectors run the upper portion of the case to connect the plates.
3	<b>Separators</b>	It's fit between the battery plates to keep them from touching & shorting against each other. The separators are made of insulating material.
4	<b>Battery Casing</b>	It encloses the elements & acid solution. It is usually made of high quality plastic.
5	<b>Battery Cover</b>	It is bonded to the top of the battery case. It seals the top of the case.
6	<b>Battery Cap</b>	It snaps into the holes or opening in the battery cover. They keep electrolyte from splashing out of the cover.
7	<b>Electrolyte (Battery Acid)</b>	It often called Battery acid is mixture of sulfuric acid & distilled water. Battery acid is poured into each cell unit the plates are covered.
8	<b>Battery Terminals</b>	It provides a means of connecting the battery plates to the cars electrical system.



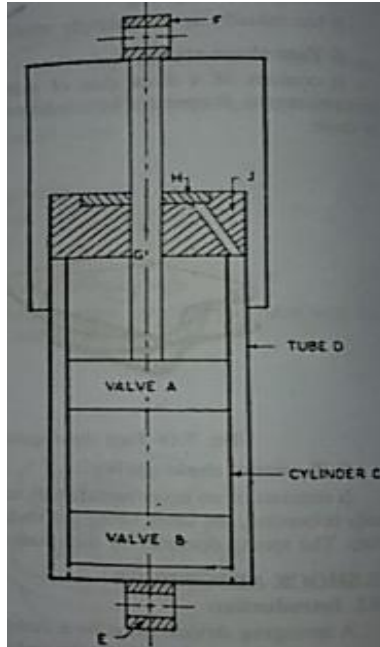
**Figure: Construction of Lead Acid Battery**

(2 Marks for Constructional Details, 2 Marks for neat Sketch)

b) Describe with neat sketch working of telescopic shock absorber.

**Working of Telescopic Shock Absorber:**

Below figure shows a simple Telescopic Shock absorber. There is a fluid in space above valve assembly (A), below (A) & also in annular space between cylinder (C) & tube (D), which is connected to the space below valve assembly (B). (H) is gland in head (J) & any fluid scrapped off by rod (G) is brought down into annular space through inclined passage shown in head. Eye (E) is connected to axle, while eye (F) is attached to chassis frame. Fluid generally used in shock absorbers is a mixture of 60 per cent Transformer oil & 40 per cent Turbine oil.



**Figure: Telescopic Shock Absorber**

**When car has come across a bump,**

- [1] Eye (E) would move up & thereby the fluid will pass from lower side of valve assembly (A) to its upper side.
- [2] Due to pressure of fluid through rod (G) fluid will be go to underside of valve (B).
- [3] This passing of fluid through valve openings provides damping.
- [4] Similarly for downward motion of eye (E), fluid will pass upper side of valve assembly (A) to lower side & also from lower side of valve assembly (B) to its upper side.

**(2 Marks for Working, 2 Marks for Labeled Sketch)**

c) **State various factors affecting tyre life.**

**Factors affecting tyre life:**

The following are the main factors which affect tyre performance and consequently their life;



**[1] Inflation:**

The tyre must be inflated according to the specification of the original vehicle manufacturer. Both the under inflation and over inflation are detrimental to tyre life.

**[2] Vehicle Maintenance:**

The state of vehicle maintenance can also affect the tyre life. Following are the main mechanical irregularities which are revealed by the typical wear of the tyre.

1. Wheel Alignment
2. Brake Adjustment
3. Matching and spacing of dual tyre

**[3] Manner of Driving:**

Apart from inflation and vehicle maintenance, the manner in which a vehicle is driven, affect the tyre life. Excessive speeding, quick starts and sudden stops all cause faster tread wear.

**[4] Overloading:**

In case of overloading the tyre has insufficient amount of air to support the dead weight carried. This results in decrease of tyre mileage.

**[5] Miscellaneous Factors:**

It includes;

1. Heat
2. Road conditions
3. Season (Weather condition)
4. Position of tier

**(Enlist any four with brief description, from the above mentioned, 1 Mark for each)**

d) **Enlist various types of vehicle layouts and explain all wheel drive type.**

**Types of Vehicle Layouts:**

**According to Engine Location:**

**[1] Two Wheel Drive Vehicle:**

- 1.1.1 Front Engine Front Wheel Drive (FFWD)
- 1.1.2 Front Engine Rear Wheel Drive (FRWD)
- 1.1.3 Rear Engine Rear Wheel Drive (RRWD)

**[2] Four (All) Wheel Drive Vehicle:**

- 2.1.1 Manual Operated Four Wheel Drive

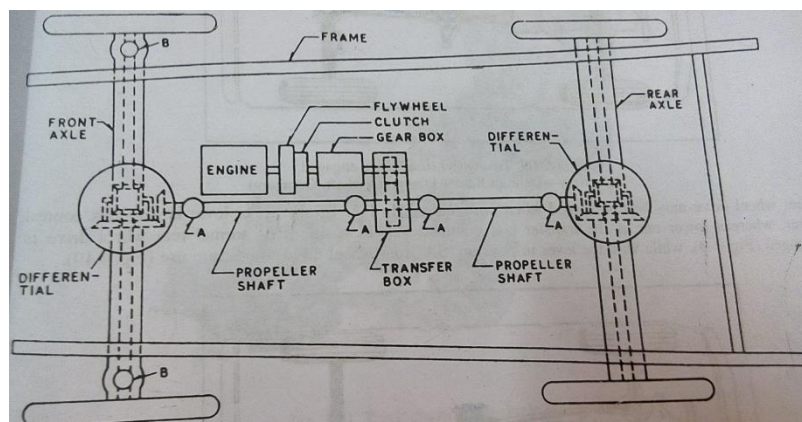
## 2.1.2 Electronic Operated Four Wheel Drive

### According to Engine Mounting:

1. Full Forward Chassis
2. Semi Forward Chassis
3. Bus Chassis

### All (Four) Wheel Drive Layout:

- [1] In this type, all the four wheels working as a drive wheels and it uses additional gear box for power transmission from front and rear side of the vehicle.
- [2] To increase manoeuvrability of the vehicle required to travel on rough unconstructed roads and tracks another arrangement known as four wheel drive is provided.
- [3] Due to all the four wheels getting driven, whole of the weight of the vehicle is available for traction.
- [4] Four wheel drives can be selected for abnormal surfaces and disconnected for normal road surfaces.
- [5] In this application, the engine and transmission are mounted longitudinally at the front.
- [6] Propeller shafts connect a transfer case, which is attached to the rear of the transmission, to final drive units on both front and rear axles.
- [7] In this layout, there are two differentials are provided at front and rear end.
- [8] The additional gear box is fitted after the main gear box known as a transfer case. It divides the torque equally between the front and rear axles.
- [9] There is a provision in the control of the transfer case so that front wheel drive may be disengaged when not required.
- [10] The constant velocity joints have to be provided in front axle, because of large angular movements involved during steering.





**Figure: Layout of All (Four) Wheel Drive Vehicle**

**(2 Marks for Types, 2 Marks for brief description of All Wheel Drive vehicle layout)**

e) **Describe color coding used in automobile wiring system.**

**Color Coding Used in Automobile Wiring System:**

[1] In order to quickly identify and also to simplify the wiring system, the cables are colored. For quick identification, insulations of various wires in a circuit are assigned different colors. The seven color code system is the general one and involves brown, yellow, red, white, green, blue and black colors.

[2] In motor vehicle wiring system there are number of wires for different systems such as head lamp, fog, side indicator, horn etc. As the wires are more for each circuit, we have limited space for making of suitable arrangement of wiring.

[3] Thus following seven color code system mentioned below, used in an automobile;

**(2 Marks for Importance, 2 Marks for Listing color codes with their function)**

S. No.	Color	Color Code	Function
1	<b>Brown</b>	<b>BR</b>	Battery Circuit
2	<b>Yellow</b>	<b>Y</b>	Generator Circuit
3	<b>White</b>	<b>W</b>	Ignition Circuit
4	<b>Green</b>	<b>G</b>	Auxiliary Circuit
5	<b>Blue</b>	<b>BL</b>	Headlamps Circuit
6	<b>Red</b>	<b>R</b>	Side & Tail Lamp Circuit
7	<b>Black</b>	<b>B</b>	Earth Circuit

Q 6 a) **Why it is necessary to charge automobile battery? When trickle battery charging method is used?**

**Necessity of Battery Charging:**

The function of charging system in an automobile is to generate, regulate and supply the electrical energy for charging the battery.

[1] To supply the current demands made by all loads.

[2] To supply whatever charge current the battery demands.

[3] To operate at idle speed.

- [4] To supply constant voltage under all conditions.
- [5] Have an efficient power-to-weight ratio.
- [6] Be reliable, quiet, and have resistance to contamination.
- [7] Require low maintenance.
- [8] Provide an indication of correct operation.

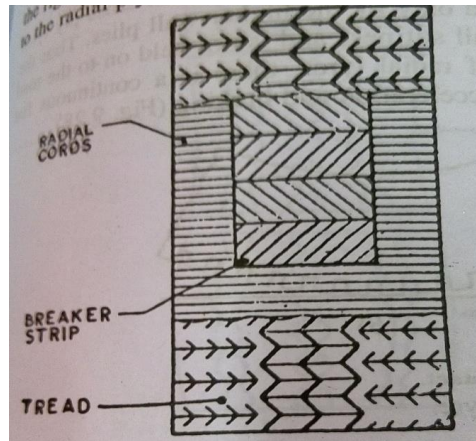
**Use of Trickle Charging Method:**

- [1] **Trickle charging** is designed to compensate for the self discharge of the battery.
- [2] In this continuous charge, i.e. long term constant current charging for standby use is possible.
- [3] The charge rate varies according to the frequency of discharge.
- [4] This method is not suitable for some battery chemistries, e.g. NiMH and Lithium, which are susceptible to damage from overcharging.
- [5] In some applications the charger is designed to switch to trickle charging when the battery is fully charged. **(4 Marks for Necessity, 4 Marks for Trickle Charging)**

b) **Draw neat sketch of radial ply tyres and cross ply tyre and describe their construction.**

**Construction of Radial Ply Tyre:**

- [1] In this ply cords run in the radial direction, i.e. in the direction of the tyre axis.
- [2] Over this structure run a number of breaker strips in the circumferential direction.
- [3] The material for the breaker strips must be flexible but inextensible, so that no change of circumference takes place with change in the amount of inflation.
- [4] The inextensible breaker strip behaves like a girder in its own plane and provides the directional stability.

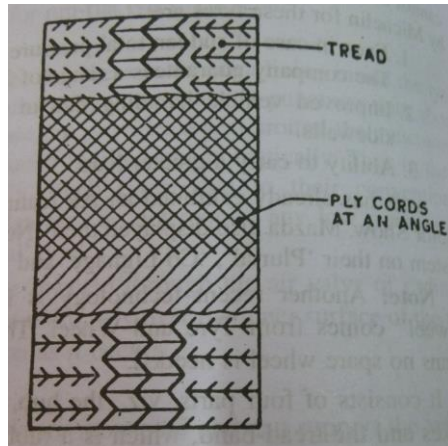




**Figure: Radial Ply Tyre**

**Construction of Cross Ply Tyre:**

- [1] In this, the ply cords are woven at an angle (30°-40°) to the tyre axis.
- [2] There are two layers, which run in opposite directions as shown in figure.
- [3] This tyre has better wear and road holding characteristics.
- [4] But they must not be fitted on front wheels only.



**Figure: Cross (Bias) Ply Tyre**

**(2 Marks for each construction, 2 Marks for each sketch)**

c) **Compare battery and magneto ignition system.**

**Difference between Battery and Magneto Ignition System:**

S.N.	Battery Ignition	Magneto Ignition
1	Required Battery	No need of Battery
2	Current is operated from Battery	Current is generated by Magneto
3	Good sparking at low speed	Poor sparking at low speed
4	Starting is easier	Starting is difficult
5	Occupies more space	Occupies less space
6	Less costly	More costly
7	Used in cars , bus trucks	Used in racing cars, scooter, motor cycles etc.

**(Enlist any 4 Points from the above mentioned, 2 Mark for each)**

