UNIT 1

Transmission System

Contents

J6NWM

Learning objectives

1. To study how the power derived from engine is transferred to rear axle.
2. To study various types of drives used to power the rear axle for its functioning.
3. To identify the obstacles faced by automobiles when goes on the road.
4. To study the various components in automobile transmission system and its uses.

1.0 Introduction

In an automobile, engine is the main source for developing the power and the power produced from it must be transmitted to the wheels of the vehicle to move it from one place to another. The system which is developed for transmitting the power from the engine to the wheels of the vehicle is called as the automobile transmission system or vehicle power transmission system. For basic needs of the vehicle and for space requirements, the manufacturers place the engines in appropriate locations and transmit the energy from the engine to the wheels by various ways. Let us discuss some of the ways how the power is transmitted to the wheels with suitable diagrams.

1.1 Transmission system

In automobiles the rotary power (or torque) is obtained from the engine. The developed power is transmitted to the rotating wheels on the road. The unit which has various components connected in between the engine and the rear wheels of the vehicle is called as the automobile power transmission system. Let us see the important parts of an automobile transmission system.

1.1.1 Parts of Transmission System

1. Clutch
2. Gear box
3. Propeller shaft
4. Universal joint
5. Differential
6. Rear axle

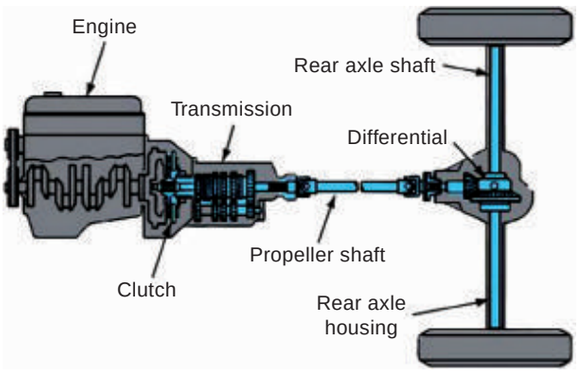

Figure 1.1.1 Important components of a transmission system of an automobile

1.2 Needs of transmission system

- For transmitting and stopping torque developed from the engine to the rear axle of the vehicle.
- For transmitting power to wheels without any noise during the engine is running.
- For avoiding vibrational effects during the transmission of power from engine to the rear wheels.
- For operating the vehicle wheels at the required speed.
- For balancing the speed of the wheels during vehicle is in running.

1.3 Types of transmission system

1. Front Engine Rear Wheel Drive
2. Front Engine Front Wheel Drive
3. Front Engine Four Wheel Drive
4. Rear Engine Rear Wheel Drive

1.3.1 Front engine rear wheel drive

Generally front engine rear wheel drive is commonly used in most of the vehicles. The power from the engine to

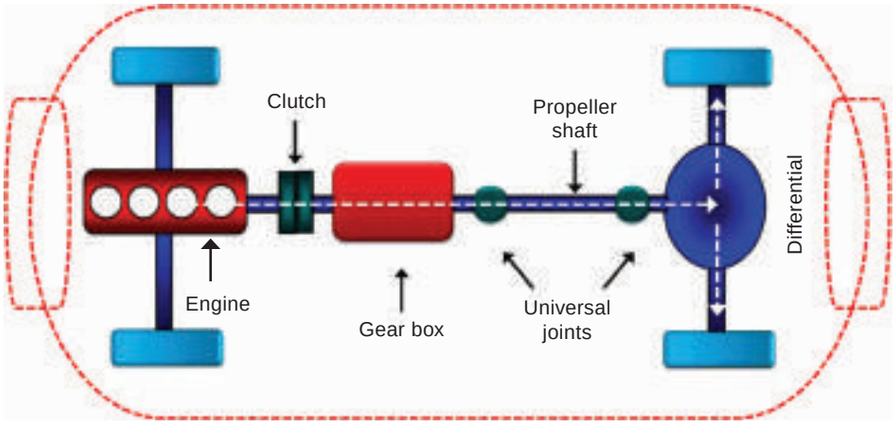

Figure 1.3.1 Front engine rear wheel drive

the running wheels is transmitted through the clutch, gearbox, universal joint and the differential unit. The front engine rear wheel drive is shown in figure 1.3.1.

Advantages

- Engine cooling is good
- Vehicle's weight is evenly distributed
- It is easy to connect the components with the engine
- It is easy to control the vehicle

Disadvantages

- Lengthy propeller shaft is needed
- Vehicle's ground clearance is high
- Vehicle's stability is low.

1.3.2 Front engine front wheel drive

In front engine front wheel drive, the clutch, gearbox and the differential unit are made as an integral part. The engine's power is transmitted to the front wheels by means of the clutch, gearbox, differential and small shaft. Propeller shaft is not necessary in such drives for transmitting the power.

Two pairs of constant velocity universal joints are used in front axle. The first one is located near the differential and another one is kept near the stub axle. To Transfer power with required angle and to transmit the steering power to the wheel these joints are being used. This type of drive is used in modern vehicles. Its construction is shown in figure 1.3.2.

Advantages

- Simple in design
- Have high stability
- Good road grip
- High engine cooling
- Good control over the vehicle
- There is no need of a separate propeller shaft

Disadvantages

- Maintenance cost is high
- Road grip is less when the vehicle is driven in slope or slanting regions
- Due to the engine's exhaust, passengers gets affected

1.3.3 Front engine four wheel drive

Four wheel drive is the one in which the engine's power is transmitted to all the four wheels at a time. The four

DO YOU KNOW?

The first modern automobile was built in 1886 by German inventor Carl Benz.

- Weight: 265 kilograms
- Maximum speed : 16 kilometers per hour
- Engine type – Four-stroke, carburetor
- Water-cooled engine
- Number of cylinders : 1
- Engine volume : 954 cm^3
- Power –0.9 horsepower (at 400 revolutions per minute)

1906, Kari Benz donates his car to the German Museum in Munich, Germany 1936. Three copies of the Karl Benz car are built for the Mercedes-Benz Museum, the Museum of Technology in Vienna and the Transport Museum in Dresden.

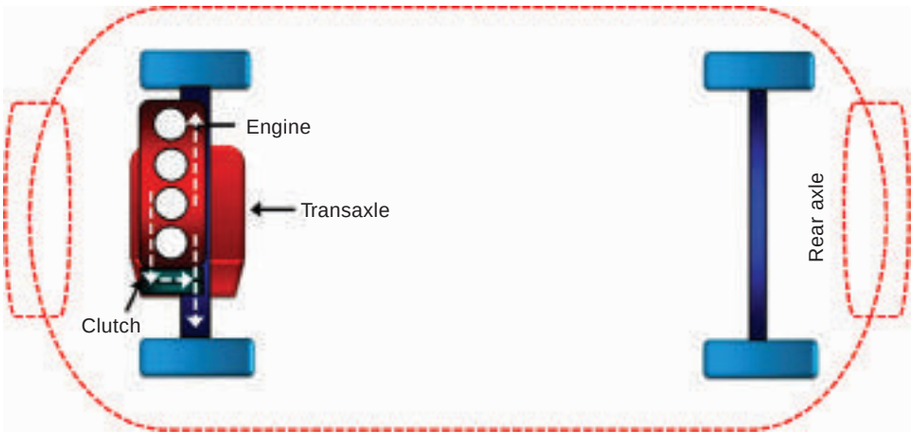

Figure 1.3.2 Front engine front wheel drive

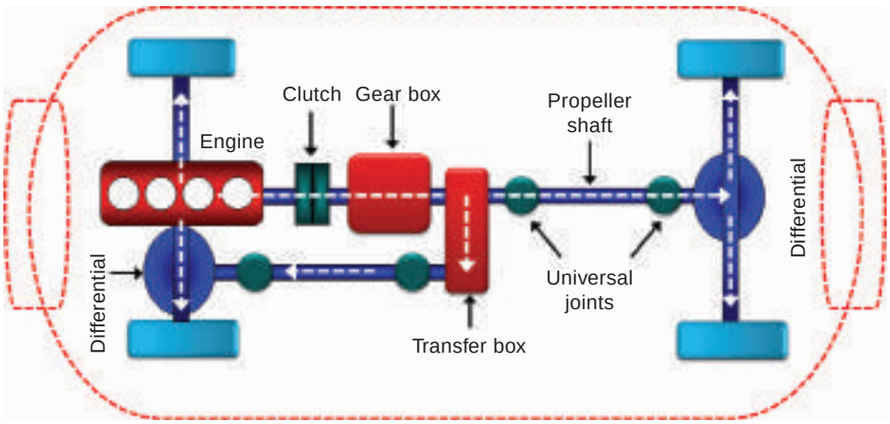

Figure 1.3.3 (a) Front engine four wheel drive

wheel drive consists of two differential units, four universal joints, one constant velocity universal joint, a propeller shaft and a transfer case.

In four wheel drive the engine's power is transmitted to the transfer case by clutch, gearbox and a small shaft. From the transfer case the power is being transferred through two propeller shafts to front and rear axle differentials, from that the power is finally transmitted to all the four wheels. In such operation high power is obtained hence four wheel drives are more suitable for mud and wet roads. Mostly four wheel drives are used in military vehicles, Jeep, special vehicles and foreign vehicles

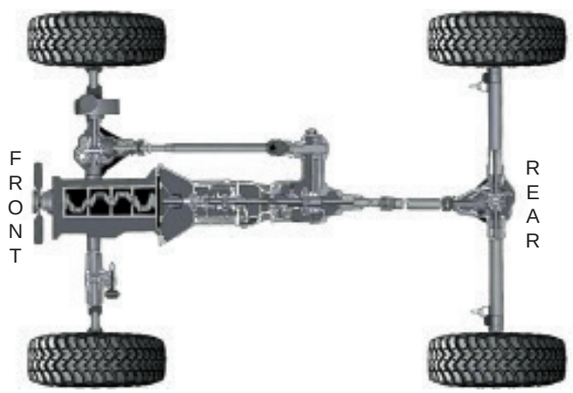

Figure 1.3.3 (b) Front engine four wheel drive

Advantages

- Pulling power is more
- Can operate vehicles in water, mud, clay and slime areas also
- Sometimes if one wheel fails to function, vehicles can operate using other three wheels

Disadvantages

- Initial cost is high
- Maintenance is high
- Complicated design
- Create more noise
- Vibration is more

1.3.4 Rear engine rear wheel drive

In the rear engine rear wheel drive clutch, gearbox and differential unit are made as a single unit. The engine power is transferred to rear wheel by means of the clutch, gearbox, differential and a small shaft. Propeller Shaft is not used. In this type of drive placing the engine's exhaust system is easy. As the driver is sitting in the front it is difficult to control clutch and gearbox. The drive needs long linkages in this type of drive

Advantages

- Simple in design
- Separate propeller shaft is not needed
- Brake power is high
- No problem to passengers because of exhaust
- No need for lengthy propeller shaft

Disadvantages

- Stability is less
- Long linkages are needed
- Maintenance is high
- Engine cooling is less.

1.4 Air resistance

On the road the blowing wind against the direction of the vehicle and the opposing force due to the vehicle speed oppose the vehicle to move front. This opposing force is called as the air resistance.

To find the air resistance of a vehicle, the following formula can be used.

$$\text{Air resistance } (R_a) = K_a \, A.V^2$$

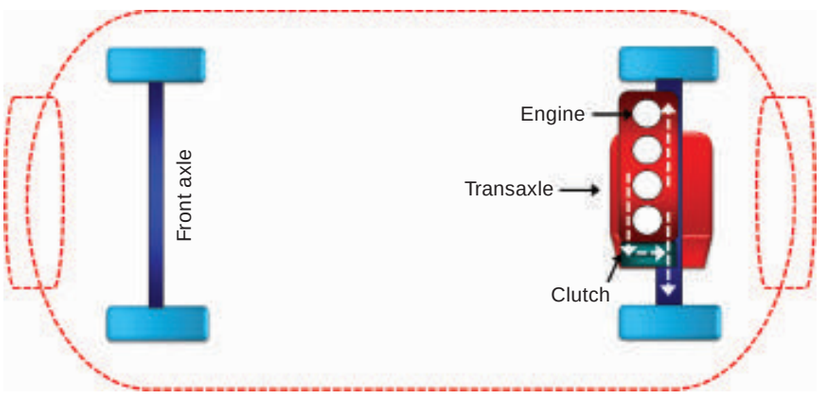

Figure 1.3.4 Rear engine Rear wheel drive

DO YOU KNOW?

- Traffic congestion wastes three billion gallons of gas each year.

- Car facts tell us that as of 2010, over 1 billion cars were being driven all over the world. The number of cars in 1986 was just half of this figure. India and China saw the greatest increase in the number of cars on their roads between these two years.

where, A = frontal area of the vehicle, in m^2

V = Velocity of the vehicle in km/hr

K_a = Co-efficient of air resistance,

= 0.0032 (car)

= 0.0046 (truck and lorry)

1.5 Rolling resistance

When the vehicle's wheel is rolling on the road, due to the mud, sand, pits, ups and down conditions of the road causes a resistance on the vehicle from its movement. This opposing force is called as the rolling resistance.

The Rolling resistance of a vehicle can be calculated by using the formula

Rolling resistance (R_r) = K.W

Where, W = Weight of the vehicle, Kg

K = Rolling Constant

= 0.005 for good road.

= 0.18 for mud road.

1.6 Gradient resistance

When a vehicle claims on the mountains or high bridges, the complete weight of the vehicle is dragged backwards because of the gravitational force which causes opposing force acting on the vehicle. This opposing force is called as gradient resistance

The gradient Resistance can be calculated by using the following formula

Gradient Resistance (R_G) = W sin θ

Where, W = Weight of vehicle, Kg

θ = Angle between straight and inclined Road

1.7 Tractive effort

When the vehicle is rolling on the road the frictional force between the top of the road and the tyre surface which is in contact on the road is called as the tractive effort.

1.7.1 Traction

Traction is defined as the action which maintains or transfers the tractive effort as same.

1.8 Basic components of Automobile

1. Frame
2. Engine
3. Clutch
4. Gear box
5. Propeller shaft
6. Rear axle
7. Front axle
8. Suspension system
9. Steering system
10. Braking system
11. Wheel and tyre and
12. The electrical system

1.8.1 Important components of the automobile chassis

The vehicle without the body is called as the Chassis. It is the under part of an automobile on which the body is mounted. The Chassis is called as the back bone of the vehicle. The structure of the chassis is shown in the above Figure 1.8.1.

1.8.2 Frame

It is a lengthy component which has cross frames joined rigidly by rivets. It is the foundation for carrying the engine, transmission system, steering system. This frame is made of stainless steel which is able to carry the whole weight of the vehicle. It is back bone of the vehicle.

1.8.3 Engine

The necessary power can be produced from the engine for running

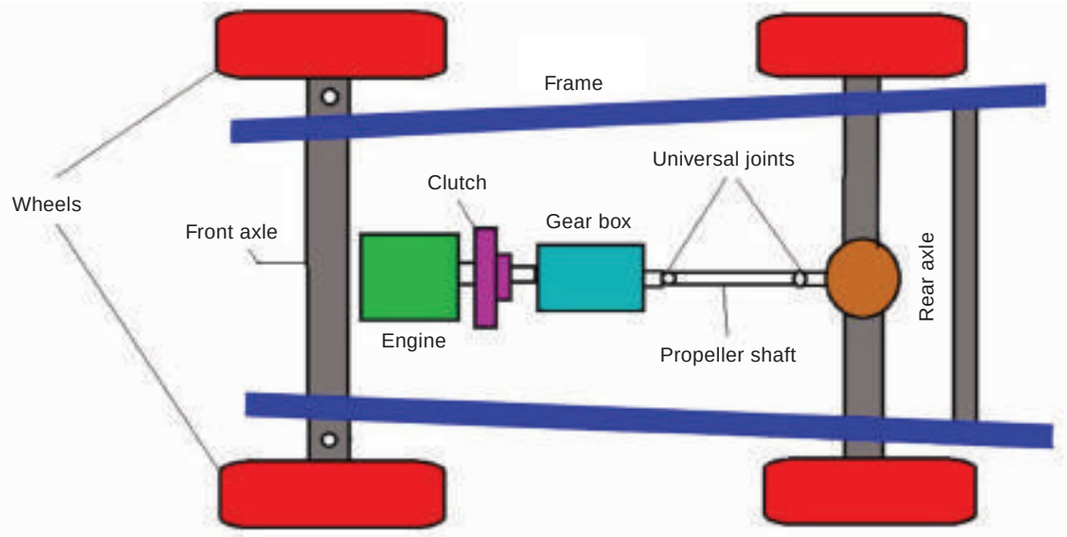

Figure 1.8.1 Important components of the Chassis

the vehicle. Petrol and Diesel are used as fuels to run the engine. It is located at the front of the vehicle. It converts the heat energy by burning the fuel into mechanical energy. Hence it is called as the heart of the vehicle.

Figure 1.8.3 Engine

1.8.4 Clutch

Clutch is a mechanical device which is used to transfer and cut the engine's power transmitted to the driveline. It is located in between engine and gear box.

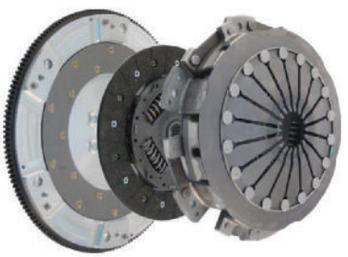

Figure 1.8.4 Clutch

1.8.5 Gear box

The box with set of gears inside the casing is called as gear box. It is used to change (increase and reduce) the speed and torque of vehicle according to different road and load conditions of the vehicle. It is shown Figure 1.8.5.

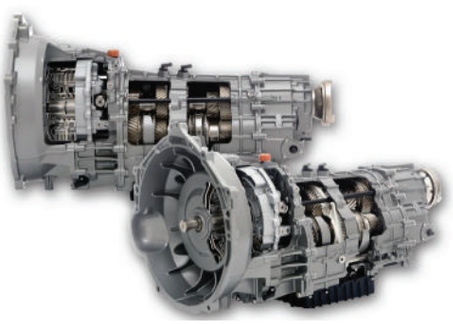

Figure 1.8.5 Gear box

1.8.6 Propeller Shaft

It is a type of long hollow shaft. This is located in between the gear box and differential. It transmits power from gear box to differential. It is shown Figure 1.8.6.

Figure 1.8.6 Propeller shaft

1.8.7 Front axle

Front wheels are coupled with front axle. Front axle carries the weight of the front part of the vehicle as well as facilitates steering and absorbs shocks due to road surface variations. It is shown Figure 1.8.7.

Figure 1.8.7 Front axle

1.8.8 Rear axle and Differential

Rear wheels are attached to the two ends of rear axle. The rear axle helps to turn the vehicle into the curved road. The differential gear in the center is cut by the speed of the cycle through the propeller shaft and then transported to 90° by wheels. It is shown Figure 1.8.8.

Figure 1.8.8 Rear Axle and Differential

1.8.9 Suspension system

The Spring Shock absorber has been connected to the front and back axles and helps to drive the vehicle smooth and slower from the vibrations in the road. It is shown Figure 1.8.9.

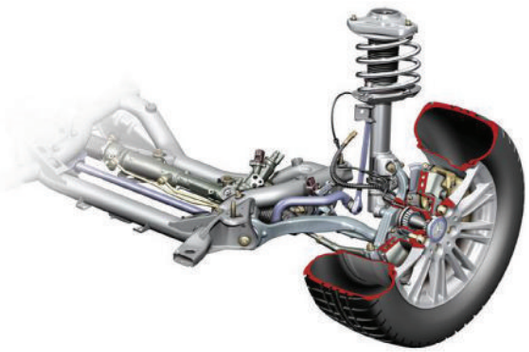

Figure 1.8.9 Suspension system

1.8.10 Steering system

The steering system operates on a very simple mechanism that directly transforms steering wheel rotation into straight line movement and helps in turn the vehicle as per the road. It is shown Figure 1.8.10.

Figure 1.8.10 Steering system

1.8.11 Braking system

Brakes are installed on the four wheels of the vehicle and work through mechanical connections, hydraulic

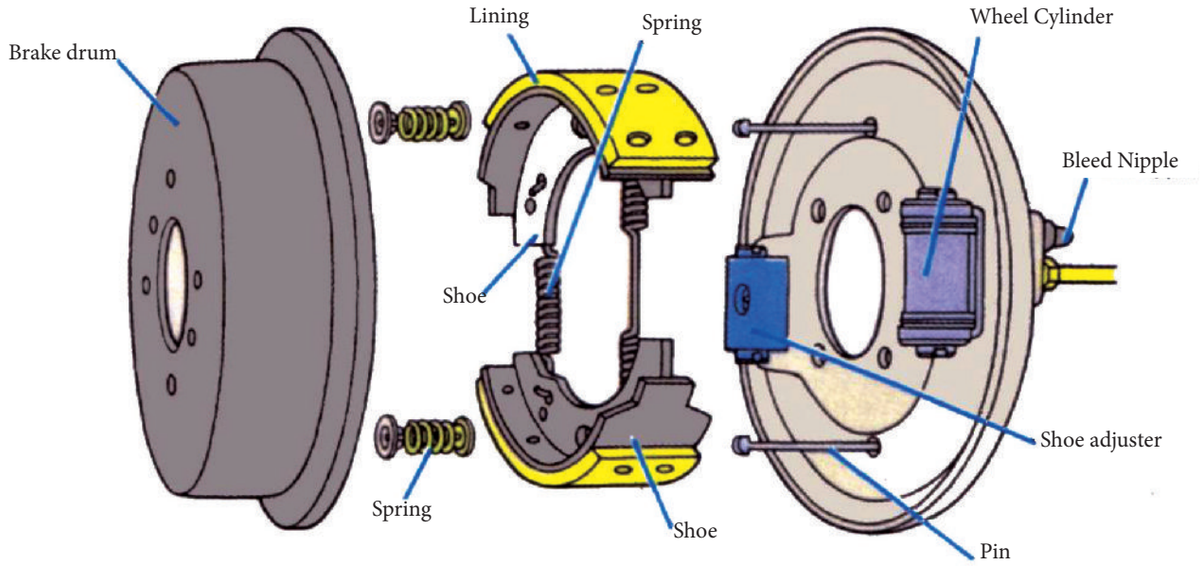

Figure 1.8.11 Braking system

and air. The very important part of an automobile is the braking system that helps to drive and control the speed of the vehicle within safe speed. It is shown Figure 1.8.11.

1.8.12 Wheels and tyres

The wheels help to carry the vehicle's entire weight and to drive the vehicle. The wheels are connected to the front and rear axles of a vehicle. They absorb the vibrations produced from the road and help to keep the tyres soft and smooth.

1.8.13 Electrical system

Electrical system supplies electrical energy which is used to produce the spark for igniting the air fuel mixture in petrol engines, to provide light for the vehicle during night ride, to operate the wiper motor, to light inside the vehicle, to play music and for dashboard lights. It is shown Figure 1.8.13.

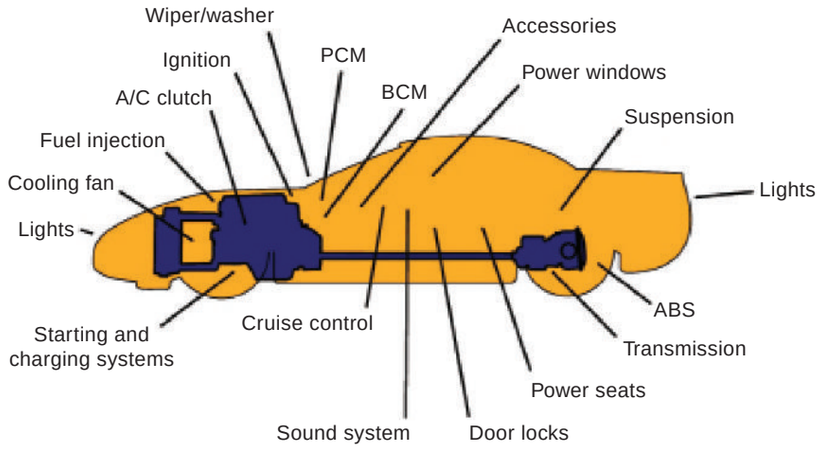

Figure 1.8.13 Basic overview of the electrical system of a modern car

Student Activity

1. Submit a report about the transmitting system by sending the students to the workshop near the school.
2. Each student have to submit a layout of the transmission system.
3. Submit a report about the front engine drive and rear engine drive in the workshops.

Glossary

1.	Transmission	–	கடத்தல்
2.	Gear box	–	பற்சக்கரப்பெட்டி
3.	Universal Joint	–	யுனிவர்சல்இணைப்பு
4.	Air Resistance	–	காற்று எதிர்ப்புத்தடை
5.	Rolling Resistance	–	உருளும்எதிர்ப்புத்தடை
6.	Gradient Resistance	–	ஏற்றத்தடை
7.	Wind Velocity	–	காற்றின்திசைவேகம்
8.	Traction	–	இழுத்தல்

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Evaluation

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PART - A

One mark questions

Choose the correct answer

1. Power produced from the engine transmits to the rotating wheels by
   a) Gear system
   b) Steering system
   c) Braking system
   d) Transmission system

2. Power is transmitted from engine to the rear axle?
   a) Front engine front wheel drive
   b) Rear engine rear wheel drive
   c) Four wheel drive
   d) Front engine rear wheel drive

3. How many types of vehicles can be divided according to the way in which the engine is located and power transmitting directions to the wheel?
   a) 8
   b) 3
   c) 4
   d) 7

4. Which engine drive provides high mountain traction and road grip?
   a) High speed drive
   b) Medium speed drive
   c) Four wheel drive
   d) Rear engine rear wheel drive

5. Which engine drive provides highest road grip?
   a) Four wheel drive
   b) Rear engine rear wheel drive
   c) Front engine front wheel drive
   d) Front engine rear wheel drive

PART - B

Three mark questions

1. Write the important parts of the transmission system.
2. Write about the types of transmission system.
3. What is mean by Air resistance?
4. What is mean by Rolling resistance?
5. What is meant by Gradient resistance?

PART - C

Five mark questions

1. Write the types of transmission system with its significance and explain any one with neat diagram.
2. Explain automobile vehicle chassis

PART - D

Ten mark questions

1. Explain any one type transmission system with sketch.
2. State the parts of chassis and explain any two parts with sketch.