



AUTOMOTIVE LEVEL-1

Students Handbook

CLASS IX



CENTRAL BOARD OF SECONDARY EDUCATION

Shiksha Kendra, 2, Community Centre, Preet Vihar, Delhi-110301



AUTOMOTIVE LEVEL-1

Students Handbook

CLASS IX



CENTRAL BOARD OF SECONDARY EDUCATION

Shiksha Kendra, 2, Community Centre, Preet Vihar, Delhi-110301

Automotive Level-1

Students Handbook, Class IX

Price: ₹

First Edition 2014, CBSE, India

Copies:

Paper Used: 80 gsm CBSE Water Mark White Maplitho

**"This book or part thereof may not be reproduced by
any person or agency in any manner."**

Published By : The Secretary, Central Board of Secondary Education,
Shiksha Kendra, 2, Community Centre, Preet Vihar, Delhi-110301

Design & Layout : Multi Graphics, 8A/101, WEA Karol Bagh, New Delhi-110005
Phone: 011-25783846, 47503846

Printed By :

भारत का संविधान

उद्देशिका

हम, भारत के लोग, भारत को एक सम्पूर्ण ¹प्रभुत्व-संपन्न समाजवादी पंथनिरपेक्ष लोकतंत्रात्मक गणराज्य बनाने के लिए, तथा उसके समस्त नागरिकों को:

सामाजिक, आर्थिक और राजनैतिक न्याय,

विचार, अभिव्यक्ति, विश्वास, धर्म

और उपासना की स्वतंत्रता,

प्रतिष्ठा और अवसर की समता

प्राप्त कराने के लिए

तथा उन सब में व्यक्ति की गरिमा

²और राष्ट्र की एकता और अखंडता

सुनिश्चित करने वाली बंधुता बढ़ाने के लिए

दृढ़संकल्प होकर अपनी इस संविधान सभा में आज तारीख 26 नवम्बर, 1949 ई० को एतद्वारा इस संविधान को अंगीकृत, अधिनियमित और आत्मार्पित करते हैं।

1. संविधान (बयालीसवां संशोधन) अधिनियम, 1976 की धारा 2 द्वारा (3.1.1977) से “प्रभुत्व-संपन्न लोकतंत्रात्मक गणराज्य” के स्थान पर प्रतिस्थापित।
2. संविधान (बयालीसवां संशोधन) अधिनियम, 1976 की धारा 2 द्वारा (3.1.1977) से “राष्ट्र की एकता” के स्थान पर प्रतिस्थापित।

भाग 4 क

मूल कर्तव्य

51 क. मूल कर्तव्य - भारत के प्रत्येक नागरिक का यह कर्तव्य होगा कि वह -

- (क) संविधान का पालन करे और उसके आदर्शों, संस्थाओं, राष्ट्रध्वज और राष्ट्रगान का आदर करे;
- (ख) स्वतंत्रता के लिए हमारे राष्ट्रीय आंदोलन को प्रेरित करने वाले उच्च आदर्शों को हृदय में संजोए रखे और उनका पालन करे;
- (ग) भारत की प्रभुता, एकता और अखंडता की रक्षा करे और उसे अक्षुण्ण रखे;
- (घ) देश की रक्षा करे और आह्वान किए जाने पर राष्ट्र की सेवा करे;
- (ङ) भारत के सभी लोगों में समरसता और समान भ्रातृत्व की भावना का निर्माण करे जो धर्म, भाषा और प्रदेश या वर्ग पर आधारित सभी भेदभाव से परे हों, ऐसी प्रथाओं का त्याग करे जो स्त्रियों के सम्मान के विरुद्ध हैं;
- (च) हमारी सामासिक संस्कृति की गौरवशाली परंपरा का महत्त्व समझे और उसका परिरक्षण करे;
- (छ) प्राकृतिक पर्यावरण की जिसके अंतर्गत वन, झील, नदी, और वन्य जीव हैं, रक्षा करे और उसका संवर्धन करे तथा प्राणी मात्र के प्रति दयाभाव रखे;
- (ज) वैज्ञानिक दृष्टिकोण, मानववाद और ज्ञानार्जन तथा सुधार की भावना का विकास करे;
- (झ) सार्वजनिक संपत्ति को सुरक्षित रखे और हिंसा से दूर रहे;
- (ञ) व्यक्तिगत और सामूहिक गतिविधियों के सभी क्षेत्रों में उत्कर्ष की ओर बढ़ने का सतत प्रयास करे जिससे राष्ट्र निरंतर बढ़ते हुए प्रयत्न और उपलब्धि की नई उंचाइयों को छू ले;
- ¹(ट) यदि माता-पिता या संरक्षक हैं, छह वर्ष से चौदह वर्ष तक की आयु वाले अपने, यथास्थिति, बालक या प्रतिपाल्य के लिये शिक्षा के अवसर प्रदान करे।

1. संविधान (छयासीवां संशोधन) अधिनियम, 2002 की धारा 4 द्वारा प्रतिस्थापित।

THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a ¹**SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC** and to secure to all its citizens :

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the² unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949, do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

-
1. Subs. by the Constitution (Forty-Second Amendment) Act. 1976, sec. 2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
 2. Subs. by the Constitution (Forty-Second Amendment) Act. 1976, sec. 2, for "unity of the Nation" (w.e.f. 3.1.1977)
-

THE CONSTITUTION OF INDIA

Chapter IV A

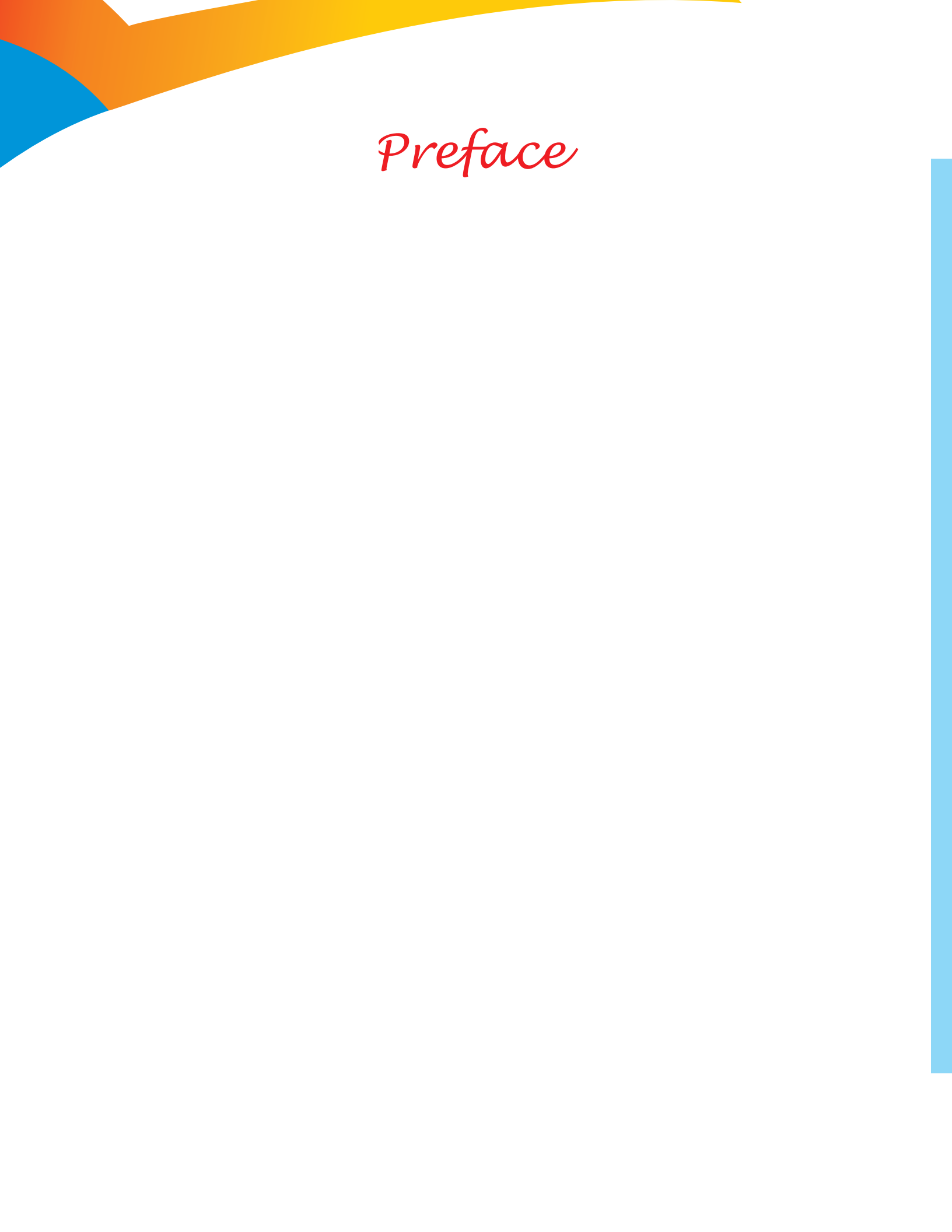
FUNDAMENTAL DUTIES

ARTICLE 51A

Fundamental Duties - It shall be the duty of every citizen of India-

- (a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;
- (b) to cherish and follow the noble ideals which inspired our national struggle for freedom;
- (c) to uphold and protect the sovereignty, unity and integrity of India;
- (d) to defend the country and render national service when called upon to do so;
- (e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;
- (f) to value and preserve the rich heritage of our composite culture;
- (g) to protect and improve the natural environment including forests, lakes, rivers, wild life and to have compassion for living creatures;
- (h) to develop the scientific temper, humanism and the spirit of inquiry and reform;
- (i) to safeguard public property and to abjure violence;
- (j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement;
- ¹(k) to provide opportunities for education to his/her child or, as the case may be, ward between age of 6 and 14 years.

-
1. Subs. by the Constitution (Eighty - Sixth Amendment) Act, 2002



Preface

Acknowledgements

Advisors

1. Dr. Satbir Bedi, IAS, Chairperson, CBSE
2. Prof. R.B. Shivgunde, Joint Director, PSSCIVE, Bhopal
3. Sh. M.V.V. Prasada Rao, Director (Voc & Edusat), CBSE

Content Developed By

1. PSSCIVE, Bhopal

Editing & Coordination

1. Dr. Biswajit Saha, Additional Director (Voc), CBSE

Contents

▶ Unit-1: History and Evolution of Automobiles	1
❖ Session - 1 : Invention of Wheel	1
❖ Session - 2 : Wheel Cart	6
❖ Session - 3 : Invention of Automobiles	8
❖ Session - 4 : Invention of Automobiles (Post World War II)	13
❖ Suggested Reading	17
▶ Unit 2: Various Types of Automobiles	19
❖ Session - 1 : Two Wheelers and Three Wheelers	19
❖ Session - 2 : Passenger Vehicles and Commercial Vehicles	24
❖ Session - 3 : Agricultural Vehicles	28
❖ Session - 4 : Construction Equipment Vehicles	32
❖ Session - 5 : Special Vehicles	35
❖ Suggested Reading	39
▶ Unit 3: Major Systems & Components of an Automobile	40
❖ Session - 1 : Chassis Frame and Auto Body	40
❖ Session - 2 : Engine and its Components	46
❖ Session - 3 : Lubrication System	58
❖ Session - 4 : Cooling System	61
❖ Session - 5 : Fuel Supply System	63
❖ Session - 6 : Transmission System	65
❖ Session - 7 : Front and Rear Axle	69
❖ Session - 8 : Steering System	72
❖ Session - 9 : Suspension System	74
❖ Session - 10 : Wheel and Tyre	76
❖ Session - 11 : Brake	78
❖ Session - 12 : Electrical and Electronic System	81
❖ Session - 13 : Air Conditioning System	83
❖ Session - 14 : Active & Passive Safety	84
❖ Suggested Reading	86

▶ Unit 4: Road Safety	86
❖ Session - 1 : Importance of Road Safety	87
❖ Session - 2 : Safe and Responsible Driving	90
❖ Session - 3 : Road Signs	94
❖ Session - 4 : Driving Rules and Registration	108
❖ Session - 5 : Driving License	111
❖ Suggested Reading	113
▶ Unit 5: Automobile and Environment	115
❖ Session - 1 : Air Pollution	115
❖ Session - 2 : Auto Emissions and EU/ BS Standards	118
❖ Session - 3 : PUC Certification	122
❖ Suggested Reading	125
	126

Unit-1

History and Evolution of Automobiles

Introduction

You must have heard the word **Automobile**. Meaning of an automobile can be auto car, motor car or car. It is a wheeled motor vehicle used for transporting goods or passengers, which also carries its own engine or motor. The word automobile comes from the Ancient Greek word (autos, "self") and the Latin *mobilis* ("movable"); therefore automobile means *a vehicle that moves itself*. The alternative name car is believed to originate from the Latin word *carrus* or *carrum* ("wheeled vehicle"), or the Middle English word *carre* ("cart") (from Old North French). These words in turn are said to have originated from the Gaulish word *karros* (a Gallic Chariot).

Most definitions of the term specify that Automobiles are designed to run primarily on roads, to have seating for one to eight people, to typically have four wheels, and to be constructed principally for the transport of people and goods.



Fig.: NANO from India

In this Unit, you will develop an understanding of the concept of wheel and role of wheel cart. You will also learn various stages of development over several hundred years that made possible the invention of an Automobile as we know it today. You will understand how various automobiles were developed in past.

SESSION-1: INVENTION OF WHEEL

Relevant Knowledge

The Wheel is considered as one of the most important mechanical inventions of all time. The wheel has been used by man since the beginning of civilization. Most primitive technologies since the invention of the wheel have been based on its principles.

The invention of the Wheel was perhaps in the late Neolithic age. It is likely that it happened along with other technological advances that gave rise to the early Bronze Age.

- | | | |
|--------------|---|---|
| 4500 BC | : | Invention of the potter's wheel, Chalcolithic (Ubaid period) |
| 4500–3300 BC | : | Chalcolithic, earliest wheeled vehicles, domestication of the horse |
| 3300–2200 BC | : | Early Bronze Age |
| 2200–1550 BC | : | Middle Bronze Age, invention of the spoked wheel and the Chariot. |

Invention of Wheel

Since the industrial revolution, the Wheel has been a basic element of nearly every machine constructed by mankind. While the exact time and place of the invention of the wheel has been disputed but its beginnings can be seen across ancient civilizations.

History tells us that wheel was most likely invented in Mesopotamia (modern day Iraq) around 3500 BC. This means that the Wheel is about 5,500 years old !

The first use of the wheel for transportation was in Mesopotamian chariots in 3200 BC. There are many references to wheeled chariots in Indian mythology also dating to around 3,000 BC. It is interesting to note that wheels may have been used in industrial or manufacturing applications before they were used on vehicles.

Egyptians started using wheel with spokes, first in chariots around 2000 BC and use of wheels seems to have started in Europe by 1400 BC.



Fig : Wheel

Wheel and Its Structure

It's hard to imagine any mechanized system that would be possible without the wheel or the idea of a symmetrical component moving in a circular motion on an axis. From tiny watch gears to automobiles, jet engines and computer disk drives, the principle is the same.

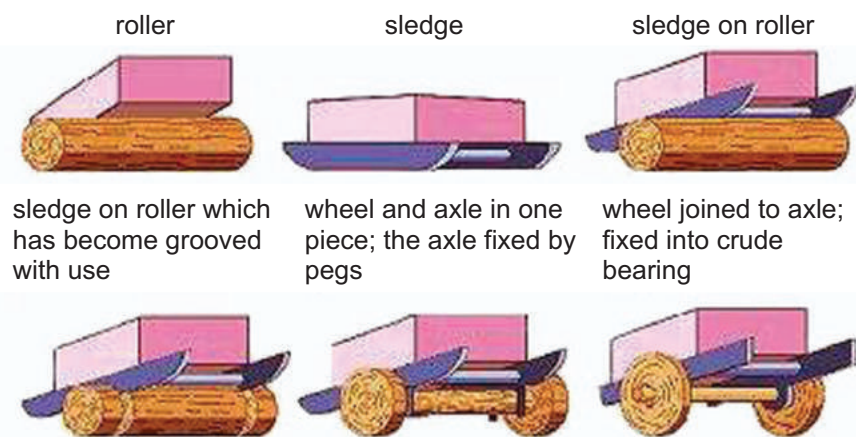


Fig : Use of Wheel

Early wheels were simple wooden disks with a hole for the axle. Because of the structure of wood, a horizontal slice of a tree trunk is not suitable, as it does not have the structural strength to support weight without collapsing, rounded pieces of longitudinal boards are required.

The oldest known example of a wooden wheel and its axle were found in 2003 in the Ljubljana Marshes some 20 km south of Ljubljana, the capital of Slovenia. According to the radiocarbon dating, it is between 5,100 and 5,350 years old. It has a diameter of 72 centimetres (28") and has been made of ash wood, whereas its axle has been made of oak.

The spoked wheel was invented more recently, and allowed the construction of lighter and swifter

vehicles. In the Harappan civilization of the Indus Valley and North Western India, we find toy-cart wheels made of clay with spokes painted or in relief, and the symbol of the spoked wheel in the script of the seals, already in the second half of the 3rd millennium BC.

The earliest known examples of wooden spoked wheels are in the context of the Andronovo culture, dating to ca 2000 BC. Soon after this, horse cultures of the Caucasus region used horse-drawn spoked -wheel war chariots for the greater part of three centuries. They moved deep into the Greek Peninsula where they joined with the existing Mediterranean peoples to give rise, eventually, to classical Greece after the breaking of Minoan dominance and consolidations led by pre-classical Sparta and Athens. Celtic Chariots introduced an iron rim around the wheel in the 1st millennium BC. The spoked wheel was in continued use without major modification until the 1870s, when wire wheels and pneumatic tires were invented.

The invention of the wheel has also been important for technology in general, important applications including the water wheel, the cogwheel (see also antikythera mechanism), the spinning wheel and the astrolabe or torquetum. More modern descendants of the wheel include the propeller, the jet engine, the flywheel (gyroscope) and the turbine.

Therefore we see that a **wheel** is a circular component that can rotate on its centre. Wheels, in conjunction with axles, allow heavy objects to be moved easily while supporting a load. The wheel is the main component of the wheel and axle assembly. Wheel and axle were used in the first carriages. We shall learn about these later.

A wheel greatly reduces friction by facilitating motion by rolling together with the use of axles. In order for wheels to rotate, a moment needs to be applied to the wheel about its axis, either by way of gravity, or by application of another external force.

The wheel is a device that enables efficient movement of an object across a surface where there is a force pressing the object to the surface. Common examples are a cart pulled by a horse and the rollers on an aircraft flap mechanism.

The low resistance to motion (compared to dragging) is explained as follows:

- ❖ the normal force at the sliding interface is the same.
- ❖ the sliding distance is reduced for a given distance of travel.
- ❖ the coefficient of friction at the interface is usually lower.

The classic spoked wheel with hub and iron rim was in use from about 500 BC (Iron Age Europe) until the 20th century AD. We can see the importance of wheel in various places and its role. Our national flag also contain a circle like wheel. Wheel is very important in our daily life. Some of important drawings of wheel are given herewith.

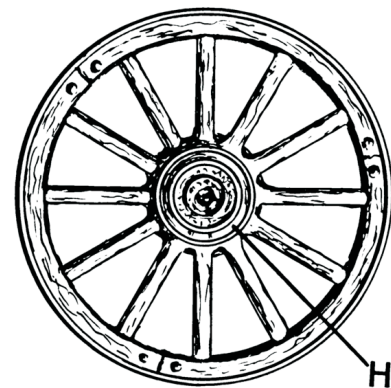
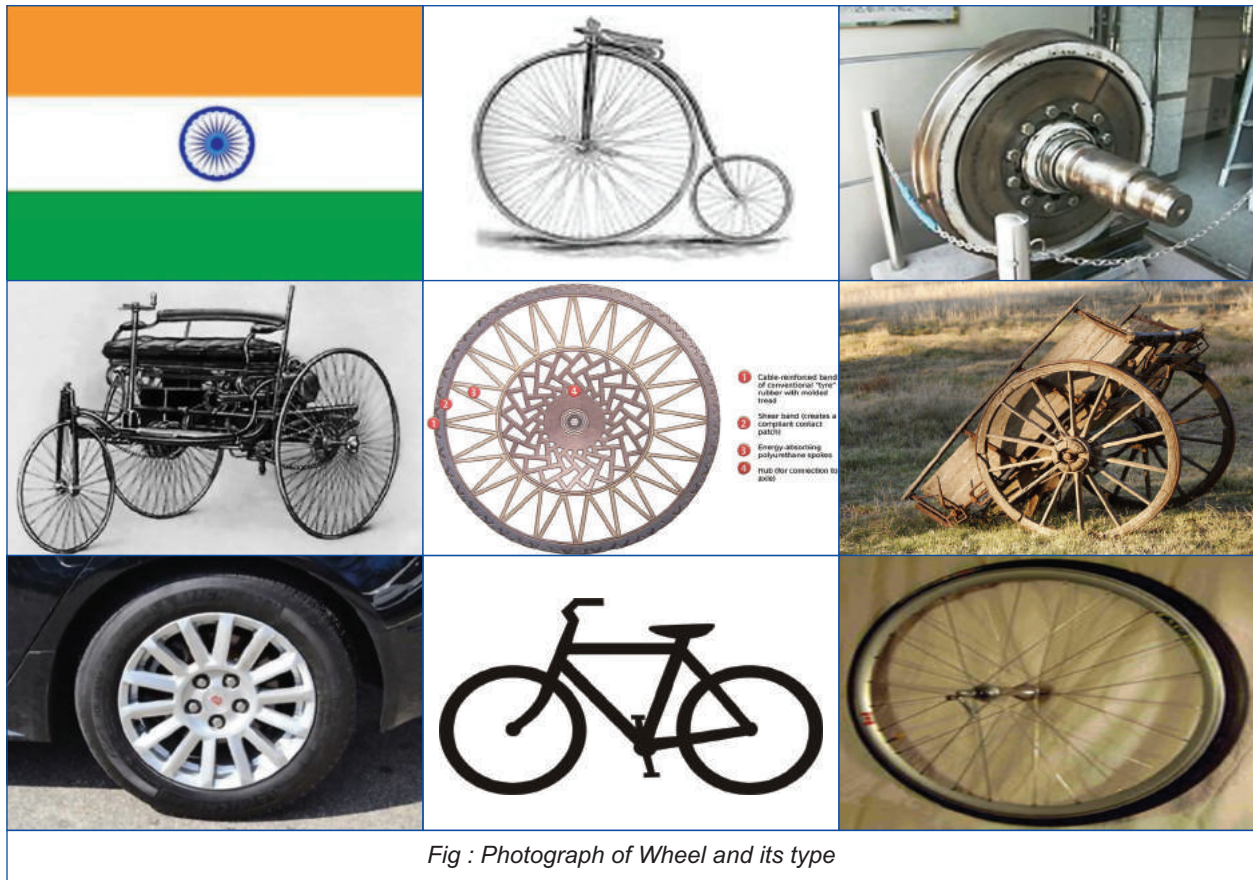


Fig : Wheel



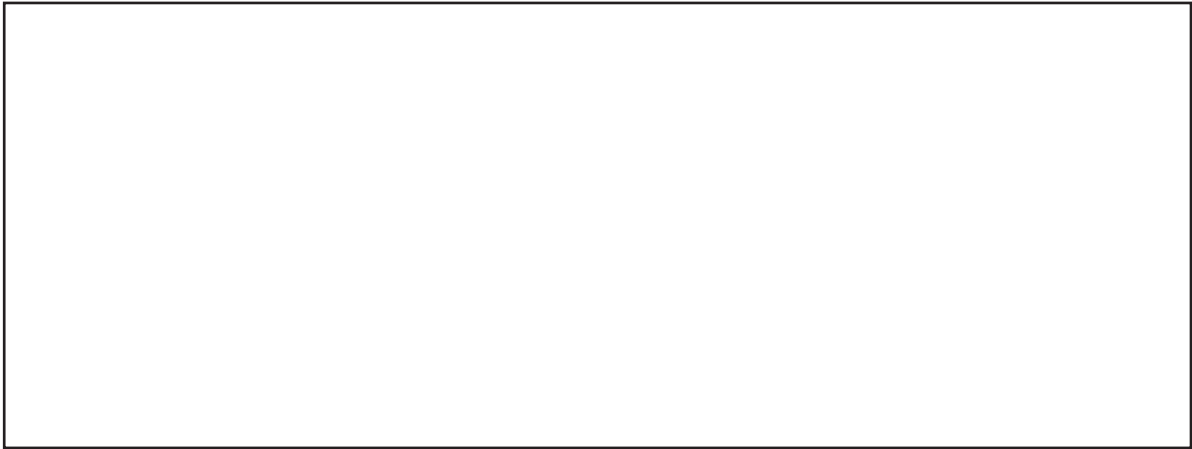


Exercise: Assignment

1. List the items where wheel has been used in machinery:

S.No.	Items	No. of Wheels
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

2. Observe and identify two types of wheels in your school and draw their diagrams:



3. Fill in the blanks:

1. _____, is considered as one of the most important mechanical inventions of all time.
2. Wheel was invented in _____ around 3500 BC which is _____ years back.
3. A wheel is a _____ component that can rotate on its centre.
4. Wheel is a _____ that enables efficient movement of an _____ across a surface where there is a force pressing the object to the surface.
5. The coefficient of friction at the interface of wheel is usually _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Differentiate between different types of wheel.

Part B

Discuss in class the following:

- What is wheel?
- Components of a wheel.
- Materials of wheel.
- Design of the wheel.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw a wheel and label its parts		
Able to identify wheel		

SESSION-2: WHEEL CART

Relevant Knowledge

Wheel cart is a vehicle designed for transport, using two wheels. A handcart is pulled or pushed by one or more people. However, from history we learn that animals instead of men were used for pulling the cart. Animals can provide more power. Normally a cart was pulled by a pair of draught animals. The draught animals used for carts may be horses or ponies, mules, oxen, water buffalo or donkeys, or even smaller animals such as goats or large dogs.



Fig.: Use of Wheel Cart

Carts have been mentioned in literature as far back as the second millennium B.C. All of you have heard about the Indian sacred book Mahabharat which depicts Lord Krishna as the sarathi the Charioteer of the Rath, the Chariot carrying Pandav prince Arjuna, in the battle field of Kurukshetra. In the Mahabharata war all the leaders used a 'rath' for fighting in the war.

Types of Carts

Larger carts may be drawn by animals, such as horses, mules, or oxen. They have been in continuous use since the invention of the wheel, in the 5th millennium BC. Carts may be named for the animal that pulls them, such as horse cart or oxcart. In modern times, horse carts are used in competitions. A dogcart, however, is usually a cart designed to carry hunting dogs: an open cart with two cross-seats back to back, the dogs could be penned between the rear-facing seat and the back end.



Fig.: Different types of cart

A bullock cart or ox cart is a two-wheeled vehicle pulled by oxen (draught cattle). It is a means of transportation used since ancient times in many parts of the world. They are still used today where modern vehicles are too expensive or the infrastructure does not favour them.

Carts are used especially for carrying goods. Bullock cart is pulled by one or two bullocks. The cart is attached to a bullock team by a special chain attached to yokes, but a rope may also be used for one or two animals. The driver and any other passengers sit on the front of the cart, while the load is placed at the back.

Horse Power

How many men would be needed to equal the power of a Horse?

Experiments were conducted to get answer to this interesting question. It was found that, on an average 10 -12 men were needed to equal the power of one Horse. This is the reason why mankind thought of using Horses for pulling the cart. This led to the development of a Horse Carriage.

Exercise: Assignment

1. List the different types of carts you have seen in your area:

S.No.	Items	No. of Wheels
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

2. Fill in the blanks:

- Cart are driven by_____.
- In Mahabharata, chariot was pulled by_____.
- A bullock cart or ox cart is a _____ pulled by oxen (draught cattle).
- An average _____ men were needed to equal the power of one horse.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Differentiate between different types of Carts.

Part B

Discuss in class the following:

- ❖ What is a Cart?
- ❖ Different types of Carts.
- ❖ Materials of Cart.
- ❖ Importance of Horsepower.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw figure of a wheel cart and label its parts		

SESSION-3: INVENTION OF AUTOMOBILES

Relevant Knowledge

Till now we have learnt how wheel was used in carts and horse powered carriages for transportation of goods and people. Engineers kept on improving the Horse Carriage design bit by bit. Parallely, man was working on a system that could be self propelled, meaning that the system could be run without any man or animal force required for moving it.

In the year 1672 the very first such model was developed in the form of a toy. This was actually a steam engine. In this the power of steam was used to provide momentum to the toy.

Further improvements continued in various parts of the world. Then in the year 1806, the first cars powered by an internal combustion engine appeared. The fuel used for running this was 'fuel gas' instead of 'steam'. Of course, the process of using Fuel Gas is different than the process required for using Steam. Steam engine requires 'External combustion', whereas, fuel gas uses the principle of 'Internal Combustion'. We shall study this in detail later.

Meanwhile, engineers continued to improve designs till the year 1885 when the first modern gasoline- or petrol-fueled engine was developed in Europe. It is important to note that inventions in science and technology can not often be used immediately by general public. One reason is that the cost of developing new technology is very high. Also, the first models usually do not have any comfort features. However, when more people demand the new models, the cost starts to come down. More features can also be added for making it attractive for general consumers.

Karl Benz a brilliant German engineer designed and patented the first practical model in 1885. This model used internal combustion Engine and was called Motorwagen. Although, several other German engineers (including Gottlieb Daimler, Wilhelm Maybach and Siegfried Marcus) were working on the problem at about the same time, Karl Benz generally is acknowledged as the inventor of the modern automobile.

An automobile powered by his own four stroke cycle gasoline engine was built in Mannheim, Germany by Karl Benz in 1885 and granted a patent in January of the following year, under the auspices of his major company, Benz & Cie., which was founded in 1883.



*Fig.: Cugnot Steam trolley
(Jonathan Holquinisbura)*



Fig.: First practical car model



Fig: Photograph of the original Benz Patent Motorwagen, first built in 1885 and awarded the patent for the concept given here)

It was an integral design, without the adaptation of other existing components and included several new technological elements to create a new concept. He began to sell his production vehicles in 1888.

In 1879, Benz was granted a patent for his first engine, which had been designed in 1878. Many of his other inventions made the use of the internal combustion engine feasible for powering a vehicle. His first *Motorwagen* was built in 1885, and he was awarded the patent for its invention, basis his application on January 29, 1886. Benz began promotion of the vehicle on July 3, 1886, and about 25 Benz vehicles were sold between 1888 and 1893, when his first four-wheeler was introduced along with a model intended for affordability. They also were powered with four-stroke engines of his own design. Emile Roger of France, already producing Benz engines under license, now added the Benz automobile to his line of products. Because France was more open to the early automobiles, initially more were built and sold in France through Roger, than Benz sold in Germany. (Bertha Benz, the first long distance automobile driver in the world in the photograph given here).



Fig: Bertha Benz, the first long distance automobile driver in the world

In August 1888 Bertha Benz, wife of Karl Benz, undertook the first road trip by car, to prove the road-worthiness of her husband's invention. During the last years of the nineteenth century, Benz was the largest automobile company in the world with 572 units produced in 1899.

Towards the end of 19th century, many automobile companies came up in Europe and America. They started producing different models. But these automobiles were very expensive and very few rich people could afford them like Kings, Queens and Rajas in India.

An average person could only dream but could not afford to own a car. Many attempts were being made in Europe and America for reducing costs. The large-scale, production-line manufacturing of affordable automobiles was started by Ransom Olds at his Oldsmobile factory in 1902 based on the assembly line techniques pioneered by Marc Isambard Brunel at the Portsmouth Block Mills, England in 1802. The assembly line style of mass production and interchangeable parts had been pioneered in the U.S. by Thomas Blanchard in 1821, at the Springfield Armory in Springfield, Massachusetts. This concept was greatly expanded by Henry Ford, beginning in 1914. With the introduction of this new manufacturing process, FORD Motor company launched the first large scale production of their Model T. In 1914, an assembly line worker could buy a Model T with four months' pay of some two hundred American car makers in existence in 1920.



Fig.: Car Ford Model T

In Europe much the same happened. Morris set up its production line at Cowley in 1924 and soon outsold Ford, while beginning in 1923 to follow Ford's practice of vertical integration. They bought Hotchkiss (engines), Wrigley (gearboxes), and Osberton (radiators), for instance, as well as competitors, such as Wolseley: in 1925, Morris had 41% of the total British car production. Most British small-car assemblers, from Abbey to Xtra had failed. Citroen did the same in France, coming to cars in 1919. Between them Renault's 10CV and Peugeot's 5CV, they produced 550,000 cars in 1925 and Mors, Hurtu, and others could not compete. Germany's first mass-manufactured car, the Opel 4PS *Laubfrosch* (Tree Frog), came off the line at Russelsheim in 1924, soon making Opel the top car builder in Germany, with 37.5% of the market.



Fig: 1926 Austin 7 Box

Between the 1st and the 2nd World Wars a lot of attention of the Automobile industry went towards development of defence vehicles. As a result several new vehicles like battle Tanks and Jeeps were developed. The tank became very popular in the war field. It is a very versatile vehicle, which can run in any road conditions i.e., in cross country terrain, hills, deserts and tranches etc.



Fig: Mark V Tank

However, during this period, there were some very interesting designs in the passenger segment also. Volkswagen in Germany developed a car in the 30s, which looked like a crawling creature and was therefore called "Beetle" This model has the engine at the back and front bonnet was used as luggage compartment. The car was very convenient to drive and also good looking and stylish. It became very popular in Europe.



Fig: Jeweled one-millionth VW Beetle

By 2002, over 21 million Type 1s had been produced, but by

2003, annual production had dropped to 30,000 from a peak of 1.3 million in 1971. Volkswagen announced the end of production in June 2003. However, the opinion in the United States was not very good. Perhaps because of the characteristic differences between the American and European car markets. Henry Ford II the grandson of original Henry Ford, once described the car as “a little box.”



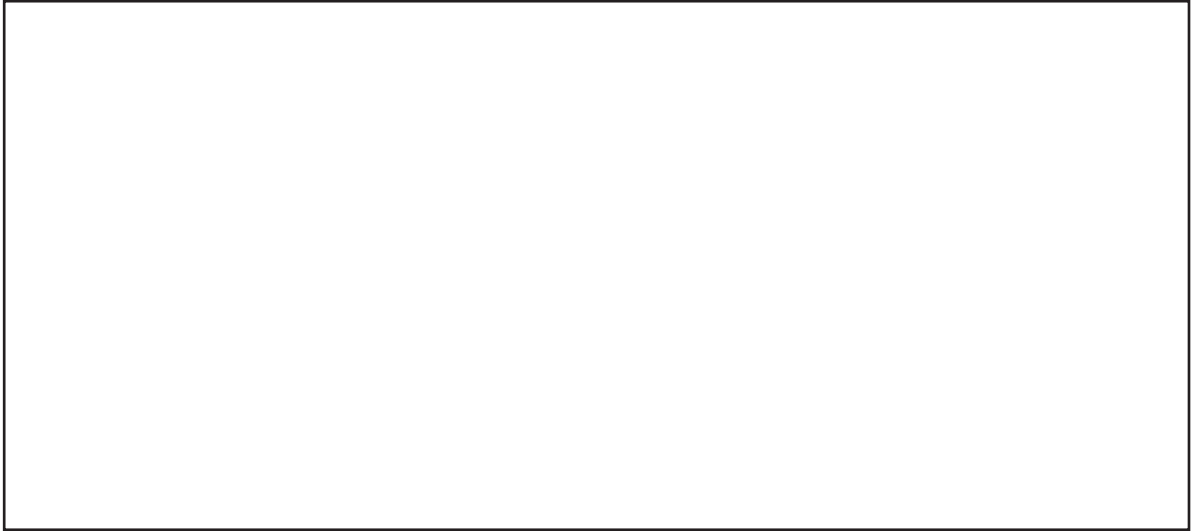
Fig:1946 GAZ-M20 Pobeda one of the first mass produced car with ponton

Exercise: Assignment

1. Make a list of automobile vehicles developed in history:

S.No.	Type of Vehicle	Model
1		
2		
3		
4		
5		

2. Collect the photograph of any vintage car seen in any magazine:



3. Fill in the blanks:

1. In the year _____ the very first such model was developed in the form of a toy.
2. In year 1806, the first cars powered by _____ appeared.
3. Karl Benz a brilliant _____ designed and patented the first practical model in 1885.
4. Volkswagen in _____ developed a car in the 30s which looked like a crawling creature and was therefore called _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for the Assessment Activity.

Part A

- ❖ Differentiate between various types of wheel invention.

Part B

Discuss in class the following:

- ❖ When was the first vehicle invented?
- ❖ Who was inventor of the first patented car?
- ❖ Why development was made in vehicles?
- ❖ Who was first rider of the car?
- ❖ Name the important manufacturers of the car.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to list important invention of automobile		

SESSION-4: INVENTION OF AUTOMOBILES (POST WORLD WAR II)

Relevant Knowledge

Till now you have gone through the development in the Automobile sector before World War II, now we will concentrate on post World War II. Automobile Industry started on rapid modernization in the 50s and 60s. Many new models of cars were introduced like Edsel, Chevrolet etc.

In USA, road network was built after the second War. This road network was very modern with long highways stretching across the length and breadth of the country. It is good to note that USA has a very big land mass and vast geography. This allows open and wide roads to be built. On these roads models like the Beetle do appear very tiny!

The Big Three of the car industry namely General Motors, Ford & Chrysler set about to design big fast moving cars for the American roads. Edsel, Buick, Pontiac Firebird, Chevrolet Impala etc were some of the big cars that came on American highways in the 50s and 60s. It may also be noted that these models used large amounts of petrol or gasoline as it is called in US. But, petrol consumption was not the main issue in those happy days. So, each car maker was competing with the other in making bigger & bigger designs with more luxuries added for comfort. All this made owning and maintaining a car quite costly. Still, more and more Americans were buying these models. One very popular model from FORD was named 'MUSTANG'.

However, things changed after 1973. This was the year of the first "Oil Crisis". Petrol started becoming costlier as all the Arab nations got together in an alliance. Now, suddenly even Americans started looking for more economical designs.

Meanwhile, quietly but with determination, Japan was developing cars for marketing worldwide, mainly in the USA. Actually, after the devastation of their country during the WW II, several Japanese companies came into existence like Toyota, Mazda, Mitsubishi, Suzuki etc. Some of these like Mazda, were using American Technology. But, these companies were also developing their own Research capabilities. As a result when the 1973 oil crisis occurred, these companies were very well positioned to roll out smaller, compact, economical models in USA.

Since then, companies like Toyota, Honda have been steadily increasing their market presence worldwide. The modern era is normally defined as the 25 years before the current year. However, there are some technical and design aspects that differentiate modern cars from antiques. Without considering the future of the car, the modern era has been one of increasing standardisation, platform sharing, and computer-aided design.

- ❖ 1966 – present Toyota Corolla – a simple small Japanese saloon/sedan that has come to be the best-selling car of all time.
- ❖ 1970 – present Range Rover – the first take on the combination of luxury and four-wheel drive utility, the original 'SUV'. Such was the popularity of the original Range Rover Classic, that a new model was not brought out until 1994.
- ❖ 1973 – present Mercedes-Benz S-Class – electronic Anti-lock Braking System, supplemental restraint airbags, seat belt pretensioners, and electronic traction control systems all made their

- debut on the S Class. These features would later become standard throughout the car industry.
- ❖ 1975 – present BMW 3 Series – the 3 Series has been on the Car and Driver magazine's annual Ten Best list 17 times, making it the longest running entry in the list.
 - ❖ 1977– present Honda Accord saloon/sedan – this Japanese sedan became the most popular car in the United States in the 1990s, pushing the Ford Taurus aside, and setting the stage for today's upscale Asian sedans.
 - ❖ 1981–1989 Dodge Aries and Plymouth Reliant – the "K-cars" that saved Chrysler as a major manufacturer. These models were some of the first successful American front-wheel drive, fuel-efficient compact cars.
 - ❖ 1983 – present Chrysler minivans – the two-box minivan design nearly pushed the station wagon out of the market, and presaged today's crossover SUVs.
 - ❖ 1984 – present Renault Espace – first mass one-volume car of noncommercial MPV class.
 - ❖ 1986 – present Ford Taurus – this mid-sized front-wheel drive sedan with modern computer-assisted design dominated the American market in the late 1980s, and created a design revolution in North America.
 - ❖ 1989 –1999 Pontiac Trans Sport – was one the first of the one box cars.
 - ❖ 1997 – present Toyota Prius – launched in the Japanese market, in September 2010 reached worldwide cumulative sales of 2.0 million units, becoming the most iconic hybrid electric vehicle in the world.
 - ❖ 1998 – present Ford Focus – one of the most popular hatchbacks across the globe, that is also one of Ford's best selling world cars.
 - ❖ 2008 – present – Tata Nano – The Tata Nano is an inexpensive(100,000), rear-engine, four-passenger city car built by the Indian company Tata Motors and is aimed primarily at the Indian domestic market.
 - ❖ 2010 – present, Nissan Leaf and Chevrolet Volt – an all-electric car and a plug-in hybrid correspondingly, were launched in the U.S. and Japanese markets in December 2010, becoming the first mass production vehicles of their kind.

Indian Automobile Scenario

We should now look at the Automobile industry in India. It started with import of cars for Royal families. Perhaps the first cars imported in India were in 1920s.

For many years India did not have any manufacturing capability of its own. Hindustan Motors is one of the original car manufacturers in India, founded in 1942 by Mr. B. M. Birla, it was a leader in car sales until the 1980s, when the industry was opened up from protection. It is



Fig : Ambassador Car

the producer of the Ambassador car, widely used as a taxicab and as a government limousine. This car is based on the Morris Oxford, a British car that dates back to 1954.

Another India company Premier Automobiles was founded in 1944. The company first launched production by building vehicles under license from Dodge and Plymouth. In 1951, they began producing versions of the Fiat 500 for the Indian market. This was followed by the Fiat 1100 in 1954. In 1973, the 'Premier' was used on their vehicles for the first time the Premier President, based on the Fiat 1100 as Premier Padmini. Ambassador and Fiat/Padmini were the two dominant models of cars on the Indian roads till 1983.



Fig : Fiat Car

In 1983, Government of India started Maruti Udyog in collaboration with Suzuki of Japan. Maruti's first model called Maruti 800 became a big success. Within 5-6 years the company reached an annual production level of nearly 1,00,000 cars per year. They launched various models like 800, Gypsy, Omni van, Esteem, Zen, Boleno etc.



Fig : Maruti Car

By the end of 90s several other global multinational car makers also started manufacturing their models in India. Among them were, General Motors, Ford, Hyundai etc.

In just a few years the Indian market for cars has become a hot spot of global automotive activity.

As we see, Indian Auto industry started with import of cars in the 20s. Then the first manufacturing started in the 40s. With continued progress many Indian companies like Maruti, Tata, Mahindra have become very big global names. Now, they are not merely manufacturing to European/American or Japanese designs. But, they are doing so with their own research & development capabilities. As a result, Nano model was developed by TATA Motors. This is the cheapest car in the world with all convenient and quality features. India is now also exporting nearly 12% of manufactured cars to Europe, USA and elsewhere in the world.

The automotive industry in India is one of the largest in the world and one of the fastest growing globally. India's passenger car and commercial vehicle manufacturing industry is the sixth largest in the world, with an annual production of more than 3.7 million units in 2010. According to recent reports, India is set to overtake Brazil to become the sixth largest passenger vehicle producer in the world, growing 16-18 per cent to sell around three million units in the course of 2011-12. In 2009, India emerged as Asia's fourth largest exporter of passenger cars, after Japan, South Korea, and Thailand. In 2010, India became Asia's third largest exporter of passenger cars, after Japan and South Korea beating Thailand.

As on 2010, India is home to 40 million passenger vehicles. More than 3.7 million automotive vehicles were produced in India in 2010 (an increase of 33.9%), making the country the second fastest growing automobile market in the world. According to the Society of Indian Automobile Manufacturers, annual vehicle sales are projected to increase to 5 million by 2015 and more than 9

million by 2020. By 2050, the country is expected to top the world in car volumes with approximately 611 million vehicles on the nation's roads.

The majority of India's car manufacturing industry is based around three clusters in the south, west and north. The southern cluster near Chennai is the biggest with 40% of the revenue share. The western hub near Maharashtra is 33% of the market. The northern cluster is primarily Haryana with 32%. Chennai, is also referred to as the "*Detroit of India*" with the India operations of Ford, Hyundai, Renault and Nissan headquartered in the city and BMW having an assembly plant on the outskirts. Chennai accounts for 60% of the country's automotive exports. Gurgaon and Manesar in Haryana form the northern cluster where the country's largest car manufacturer, Maruti Suzuki, is based. The Chakan corridor near Pune, Maharashtra is the western cluster with companies like General Motors, Volkswagen, Skoda, Mahindra and Mahindra, Tata Motors, Mercedes Benz, Land Rover, Fiat and Force Motors having assembly plants in the area. Aurangabad with Audi, Skoda and Volkswagen also forms part of the western cluster. Another emerging cluster is in the state of Gujarat with manufacturing facility of General Motors in Halol and further planned for Tata Nano at Sanand. Ford, Maruti Suzuki and Peugeot-Citroen plants are also set to come up in Gujarat. Kolkatta with Hindustan Motors, Noida with Honda and Bangalore with Toyota are some of the other automotive manufacturing regions around the country.

Exercise: Assignment

1. List the models of car running in your area:

S.No.	Name of Model
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Observe a car and draw its diagram:



3. Fill in the blanks:

- a) One very popular model from FORD was named _____.
- b) Big Three of car industry namely General Motors, Ford & Chrysler set about to design big fast moving cars for the _____ roads.
- c) First cars imported in India were in _____.
- d) Ambassador and Fiat/ Padmini were the two dominant models of _____ on the Indian roads till 1983.
- e) In 1983, Government of India started Maruti Udyog in collaboration with _____ of Japan.
- f) First Cheapest Indian car name is _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Discuss the automotive industry of India.

Part B

Discuss in class the following:

- ❖ When were cars imported in India?
- ❖ Manufacturers of Indian Car.
- ❖ Development of Automobiles in India.
- ❖ Cluster of auto in India.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to make a list of Indian automobile manufactures.		

Suggested Reading

Books

Title	Author	Publisher
Automobile Engineering Vol I	Kirpal Singh	Standard Publishers
Automobile Engineering, Vol II	Kirpal Singh	Standard Publishers
Text Book of Automobile Engineering	R. K. Rajput	Laxmi Publications
Automobile Engineering	R. K. Singal	S. K. Kataria and Sons
Automobile Engineering Theory	Kapil Dev	Computech Publications
Automobile Engineering	K. M. Moeed	S. K. Kataria and Sons

Websites

- ❖ auto.indiamart.com/auto-technology
- ❖ www.automobileindia.com/consumer-guide/automobile-technology
- ❖ auto.indiamart.com/auto-technology
- ❖ books.google.com/books/about/Automobile_Engineering.html
- ❖ www.bikeadvice.org
- ❖ www.wikipedia.com
- ❖ www.tatamotor.com

List of Contributors

1. Mr. Sunil K. Chaturvedi, CEO, Automotive Skills Development Council, Core 4-B 5th Floor India Habitat Centre, Lodhi Road, New Delhi – 110 003.
2. Mr. A.C. Deb, Sr. Lecturer, (Auto) – HOD, Pusa Polytechnic Pusa, New Delhi -110012.
3. Mr. Vikas Gautam, S.B.V. NO.1, Morigate, Delhi – 110006.
4. Prof. A.P. Verma, Ex. HOD, PSSCIVE, Bhopal.
5. Sh. Deepak Shudhalwar, Assistant Professor, E & T Division, PSSCIVE, Bhopal.
6. Dr. Saurabh Prakash, Associate Professor, E & T Division, PSSCIVE, Bhopal – Programme Coordinator.

Unit-2

Various Types of Automobiles

Introduction

The Automotive industry in India is one of the largest in the world and one of the fastest growing globally. India's Passenger Car and Commercial Vehicle manufacturing industry is the seventh largest in the world, with an annual production of more than million units in 2011.

The Automobile segment comprises of the following four broad categories of vehicles:

- Two-Wheelers and Three-Wheelers
- Passenger Vehicles
- Commercial Vehicles
- Special Application Vehicles

Two-Wheelers, being the most popular means of personal transport, account for about 75% of the total automobile production in India, while Passenger Vehicles account for nearly 16% of the production. However, owing to their lower price. Two wheelers account for only around 32% of the sales in terms of value, while Passenger Vehicles account for around 62% of sales.

As of 2010, India is home to 40 million Passenger Vehicles. More than 3.7 million Automotive Vehicles were produced in India in 2010 (an increase of 33.9%), making the country the second fastest growing automobile market in the world. According to the Society of Indian Automobile Manufacturers, annual vehicle sales are projected to increase to 5 million by 2015 and to more than 9 million by 2020. By 2050, the country is expected to be at the top the world in car volumes with more than 600 million vehicles on the nation's roads.

In this Unit, you will develop an understanding of the different types of vehicles used in our country viz., Two Wheeler, Three Wheeler, Passenger Vehicles, Commercial Vehicles, Agricultural Vehicles, Construction Equipment Vehicles and Special Application Vehicles.

SESSION-1: TWO WHEELERS AND THREE WHEELERS

Relevant Knowledge

Two Wheelers

As the name suggests, a two wheeler refers to vehicles, that run on two wheels. Two wheelers are used all over the world. In developed, rich countries, two wheelers are used more for recreational purpose. Whereas in our country it is an important means of transportation of passengers, both in urban as well as rural areas. India has the largest population of two wheelers. More than 5.4 million two wheelers are produced in our country every year. Motorcycles, Scooters and Mopeds are the categories of two wheelers in our country. Motorcycle segment is about 78% in two wheeler segment. Balance 22%, comprise of the scooters and mopeds.

India is the second largest producer of two-wheelers in the world. In the last few years, the Indian two-wheeler industry has seen spectacular growth. The country stands next to China and Japan in terms of production and sales respectively.

Majority of Indians, especially the youngsters, prefer motorbikes rather than cars. Capturing a large share in the two-wheeler industry, bikes and scooters cover a major segment. Bikes are considered to be the favourite among the youth as they help in easy commutation and also look stylish. Large variety of two wheelers are available in the market, known for their latest technology and enhanced mileage. Indian bikes, scooters and mopeds represent style and class for both men and women in India.

Benefits of Two Wheelers

Two-wheelers are the most popular and highly sought out medium of transport in India. The trend of owning Two-Wheelers is due to their:

- ◆ Economical price
- ◆ Safety
- ◆ Fuel-efficiency
- ◆ Comfort level

However, some Indian bike enthusiasts prefer high performance imported bikes. Some of the most popular high-speed bikes are Suzuki Hayabusa, Kawasaki Ninja, Suzuki Zeus and Honda Unicorn. These super bikes are specially designed for those who have a zeal for power and speed.

We can conclude that a motorcycle is a motor-powered two wheeler, similar in construction with bicycles.

Identification of Two Wheeler:

You must have seen various types of two wheelers in your area or on the roads. Every Two Wheeler has a sticker of its model type and name of the manufacturer. You can identify the make of the Two Wheeler by the sticker/logo fixed on body. Popular brands of Two Wheeler manufacturers are Hero, Honda, Bajaj, TVS, Suzuki. Two Wheeler manufacturers produces different models as per given specification. Some of famous models are given below:

- | | | |
|-------------|---|--|
| Hero make | - | Impulse, Splendor, CDdawn, Pleasure, Passion Plus |
| Bajaj make | - | Pulsar , Discover, Platina |
| TVS make | - | Apache, Star, Scooty streak, Scooty Pep, Star City |
| Honda make | - | Activa, Dio, aviator |
| Suzuki make | - | Access, Intruder M800, Zeus |

These models vary by size, weight, dimension type size, engine capacity.



Fig : Photograph of popular two

Three Wheelers

A Three-Wheeler is a vehicle with three wheels, either "human or people powered vehicles" (HPV or PPV) or motorized vehicles in the form of a trimotorcycle, all-terrain vehicle (ATV) or automobile.

Auto rickshaws (often called just auto) are common all over India, and provide cheap and efficient transportation. New auto rickshaws run on CNG and are environmentally friendly. Typical mileage for an Indian-made auto rickshaw is around 35 kilometers per liter of petrol (about 2.9 L per 100 km, or 82 miles per gallon [United States (wet measure), 100 miles per gallon Imperial (United Kingdom, Canada)]). Many major nationalized banks in India offer loans to self-employed individuals seeking to buy auto rickshaws. Auto rickshaw manufacturers in India include Bajaj Auto, Kumar Motors, Kerala Auto Limited, Force Motors (previously *Bajaj Tempo*), Mahindra & Mahindra, Piaggio Ape and TVS Motors. Auto rickshaws are found in cities, villages and in the countryside.

There are two types of auto rickshaws in India. In older versions the engines were situated below driver's seat. In newer versions engines are in rear portion. They normally run on petrol, CNG and diesel. The seating capacity of a normal rickshaw is 4, including the driver. There are also six seated rickshaws in parts of Maharashtra. In cities and towns across India it is the backbone of city transport. Normally their fare rates are controlled by govt. They have traffic meters.

Many three-wheelers which exist in the form of motorcycle-based machines are called trikes and often have the front single wheel and mechanics similar to that of a motorcycle and the rear axle similar to that of a car. Sometimes such vehicles are owner-constructed using a portion of a rear engine, rear-drive Volkswagen Beetle in combination with a motorcycle front end.

Other trikes include ATVs that are specially constructed for off road use. Three-wheeled automobiles can have either one wheel at the back and two at the front, (for example: Morgan Motor Company) or one wheel at the front and two at the back (such as the Reliant Robin).



Fig.: Photograph of popular three wheelers



Fig.: Photograph of popular three auto wheelers

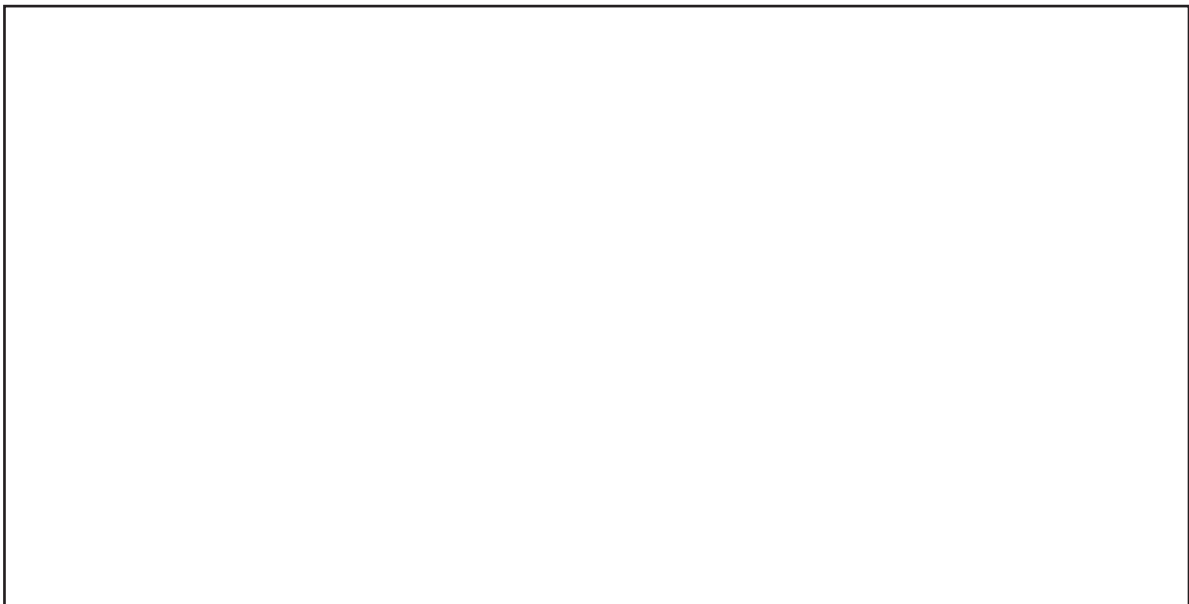
These are some of the popular three wheeler which are used for transporting of people and goods.

Exercise: Assignment

1. List the models of two wheelers and three wheelers used in your area:

S.No.	Name of Model
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Observe and identify two types of two wheelers in your school and draw their diagrams:



3. Fill in the blanks:

- a) A two wheeler refers to _____ that run on two wheels. Two wheelers are used all over the _____.
- b) More than 5.4 million _____ are produced in our country every year.
- c) A Majority of Indians, especially the youngsters prefer _____ rather than cars.
- d) Motorcycle is a motor-powered _____, similar in construction to bicycles.

- e) A three-wheeler is a vehicle with _____ either "human or people-powered vehicles" (HPV or PPV) or motorized vehicles in the form of a _____ or automobile.
- f) Auto rickshaws are _____ all over India, and provide cheap and efficient _____.
- g) New auto rickshaws run on _____ and are environmentally friendly.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Differentiate between two wheelers and three wheelers.

Part B

Discuss in class the following:

- ❖ What is meaning of a two wheeler and three wheelers?
- ❖ What are the different types of make of two wheelers?
- ❖ Why we use two wheelers mostly?
- ❖ Why three wheelers are used popularly.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw two wheelers and three wheelers		
Able to distinguish between scooters, mopeds and motorcycles		
Able to identify two wheelers and three wheelers		

SESSION-2: PASSENGER VEHICLES AND COMMERCIAL VEHICLES

Relevant Knowledge

Passenger Vehicles

Passenger vehicle refers to a machine that can carry a person or a group of persons. There are several types of passenger vehicles like cars/jeeps/tempo etc. you must have seen various models of passenger vehicles in your village, town or city. You must have also travelled in these passenger vehicles.

Some of the popular model of cars, buses, jeep, and tempo are illustrated below:

Car: A motor car or car is a wheeled motor vehicle used for transporting passengers, which also carries its own engine or motor. Various popular cars in India are Maruti Suzuki, Tata motor, Hyundai etc. Now a days various car manufacturers of International level have established in our country and started production of cars etc.



Fig: Photograph of popular four wheelers



Fig : Important passenger vehicle used in our country

Jeep: Jeep was first produced by Willys Overland. Jeep celebrated its 70th anniversary in 2011 and it is the oldest off road vehicle and SUV in the world. Jeep is a brand of Chrysler. Jeep is mainly used for its excellent off road capabilities. Jeep was primarily designed and constructed to aid military requirements. Slowly changes were made and the company started producing civilian models. It has gone through various changes under different leaderships. It is part of Chrysler

Group LLC which is now part of FIAT Italy. Jeep is found in many countries around the world. The models in Jeep range are Jeep Grand Cherokee, Jeep Patriot, Jeep Compass, Jeep Liberty, Jeep Commander and Jeep Wrangler.

Commercial Vehicles

A Commercial Vehicle is a type of motor vehicle that may be used for transporting of goods as well passengers. Commercial vehicles influence the trade, commerce and industry of a country in a major way. Vehicles falling under this category are mainly buses & trucks.

It comes in various uses such as transportation of goods, shipping and handling of various commodities and so on. The future of companies manufacturing these vehicles is very bright due to India's growing commercial sector. The export of commercial vehicles has gone up considerably breaking all previous records.

Trucks are basically used for carrying goods and materials in bulk. These trucks are classified into sub-categories depending on their size and functional use: haulage, rigid trucks, tippers, cabs, delivery vans and trailers. The fuel efficiency of these vehicles have also improved to a great extent in the past few years. The major players of truck manufacturers in India are Ashok Leyland, Eicher, Tata Motors and Swaraj Mazda.

A Bus is a huge commercial vehicle, said to have originated in France in the year 1826 designed by Stanislas Baudry under the name of 'Omnibus'. The basic purpose of this vehicle is to carry the passengers as it is an easy and cost-effective medium of transport.

The major producers of buses in India are Ashok Leyland and Tata Motors, Swaraj Mazda, Volvo and Hindustan Motors have made a big name in manufacturing mini-buses. However, there are huge subcategories of buses like Commuter Bus, School buses, Electric buses and so on. In India, CNG buses have occupied a huge market thus making it fuel efficient and environmental friendly vehicle.



Fig : Photograph of popular bus



Fig : Photograph of CNG Buses



Fig : Photograph of popular tempo

Exercise: Assignment

1. List the models of passenger vehicle and commercial vehicle used in your area:

S.No.	Name of Model
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Observe and identify two types of passenger and commercial vehicles in your area and draw their diagrams:

3. Fill in the blanks:

- a) A passenger vehicle refers to that run on _____ wheels.
- b) Model of cars, buses, jeep, and tempo are _____ in our country every year.
- c) Jeep is a _____ vehicle.
- d) A Passenger vehicles are used for transporting _____.
- e) Commercial vehicle is used for _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Differentiate between passenger vehicle and commercial vehicle.

Part B

Discuss in class the following:

- ❖ Who invented Jeep?
- ❖ What are the different makes of a bus?
- ❖ Why do we use car mostly?
- ❖ Why cars and jeeps are used popularly.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw Passenger vehicles and Commercial Vehicles		
Able to distinguish between Passenger vehicles and Commercial Vehicles		
Able to identify two Passenger vehicles and Commercial Vehicles		

SESSION-3: AGRICULTURAL VEHICLES

Relevant Knowledge

You must have seen tractors in your area. Do you know the meaning of tractor? It can be said that a tractor is an engineering vehicle specifically designed to deliver a high attractive effort (or torque) at slow speeds, for the purposes of hauling a trailer or machinery used in agriculture or construction. Most commonly, the term is used to describe a farm vehicle that provides the power and traction to mechanize agricultural tasks, especially (and originally) till age, but nowadays a great variety of tasks. Agricultural implements may be towed behind or



Fig : Photograph of Tractor

mounted on the tractor, and the tractor, may also provide a source of power if the implement is mechanised.

The word tractor was taken from Latin, being the agent noun of *trahere* "to pull". The first recorded use of the word meaning "an engine or vehicle for pulling wagons or ploughs" occurred in 1901, displacing the earlier term "traction engine" (1859). Tractors are heavy vehicles serving the purpose of hauling at an extremely low speed. India being one of the major agricultural country, makes the use of tractors on a large scale. It is one of the heaviest vehicle, basically used for carrying out the agricultural tasks in an effective way.

Modern tractors usually employ diesel engines which deliver 18 to 575 horsepower. The major producers of tractors in India are Ashok Leyland, Escorts, Force Motors and Swaraj Enterprise. The most common use of the term "tractor" is for the vehicles used on farms. The farm tractor is used for pulling or pushing agricultural machinery or trailers, for plowing, tilling, disking, harrowing, planting and similar tasks. A variety of specialty farm tractors have been developed for particular uses. These include row crop tractors with adjustable tread width to allow the tractor to pass down



Fig : Photograph of Tractor

rows of corn, tomatoes or other crops. Many utility tractors are used for non-farm grading, landscape maintenance and excavation purposes, particularly with loaders, backhoes, pallet forks and similar devices. Small garden or lawn tractors designed for suburban and semirural gardening and landscape maintenance also exist in a variety of configurations.

The durability and engine power of tractors make them very suitable for engineering tasks. Tractors can be fitted with engineering tools such as dozer blades, buckets, hoes, rippers, etc. The most common attachments for the front of a tractor are dozer blades or buckets. When attached to engineering tools, the tractor is called an engineering vehicle.

Combine Harvester: The combine harvester, or simply combine, is a machine that harvests grain crops. The name derives from the fact that it combines three separate operations, reaping, threshing, and winnowing, into a single process. Among the crops harvested with a combine are wheat, oats, rye, barley, corn (maize), soybeans and flax (linseed). The waste straw left behind on the field is the remaining dried stems and leaves of the crop with limited nutrients which is either chopped and spread on the field or baled for feed and bedding for livestock.



Fig : Photograph of Combine Harvester

Combine harvesters are one of the most economically important labor saving inventions, enabling a small fraction of the population to be engaged in agriculture.

 4LL-200
Combine Harvester



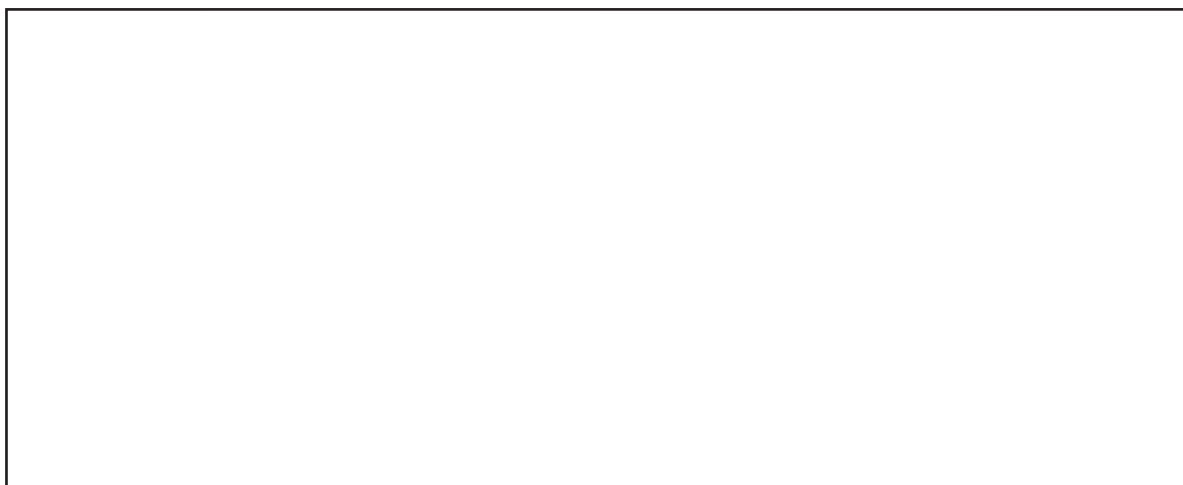
Fig : Photograph of Combine Harvester

Exercise: Assignment

1. List the models of agricultural vehicles used in your area:

S.No.	Name of Model
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Observe and identify two types of agricultural vehicles in your area and draw their diagrams:



3. Fill in the blanks:

- a) Agricultural _____ may be towed behind or mounted on the tractor.
- b) An agricultural vehicle refers to that run on _____ wheels.
- c) Combines are used for _____ and _____.
- d) Advantages of using combine are _____.
- e) Combine harvesters are one of the most economically important _____ inventions.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Differentiate between tractors and combines.

Part B

Discuss in class the following:

- ❖ Why a tractor is used?
- ❖ What are the different types of tractors?
- ❖ What are advantages of using combines ?
- ❖ In India, tractors are used popularly.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw tractor		
Able to distinguish between tractor and combine		

SESSION-4: CONSTRUCTION EQUIPMENT VEHICLES

Relevant Knowledge

Lot of new roads, houses and plants are being built these days. You must have seen big machines that reach the construction site to dig earth. These are Special Purpose Automobiles and are sometime called Earth Moving Equipments.

There are several types of earthmoving or construction equipments such as:

- ❖ Dumpers
- ❖ Dozers
- ❖ Road rollers
- ❖ Tillers
- ❖ Excavators

As their various names suggest they are used for various types of work like digging or excavating earth and dumping it at a designated place. Road rollers are used for leveling roads.

Bulldozer : A bulldozer is a crawler (continuous tracked tractor) equipped with a substantial metal plate (known as a blade) used to push large quantities of soil, sand, rubble, or other such material during construction or conversion work and typically equipped at the rear with a claw-like device (known as a ripper) to loosen densely-compacted materials.

Bulldozers can be found on a wide range of sites, mines and quarries, military bases, heavy industry factories, engineering projects and farms.

The term "bulldozer" is often used erroneously to mean any heavy equipment (sometimes a loader and sometimes an excavator), but precisely, the term refers only to a tractor (usually tracked) fitted with a dozer blade. Most often, bulldozers are large and powerful tracked heavy equipment. The tracks give them excellent ground hold and mobility through very rough terrain. Wide tracks help distribute the bulldozer's weight over a large area (decreasing pressure), thus preventing it from sinking in sandy or muddy ground. Extra wide tracks are known as 'swamp tracks'. Bulldozers have excellent ground hold and a *torque divider* designed to convert the engine's power into improved dragging ability. The Caterpillar D9, for example, can easily tow tanks that weigh more than 70 tons. Because of these attributes, bulldozers are used to clear areas of obstacles, shrubbery, burnt vehicles, and remains of structures. The bulldozer's primary tools are the blade and the ripper.



Fig : Photograph of bulldozer

Road Roller: A road roller (sometimes called a *roller-compactor*, or just *roller*) is a compactor type engineering vehicle used to compact soil, gravel, concrete, or asphalt in the construction of roads

and foundations. Similar rollers are used also at landfills or in agriculture. In some parts of the world, road rollers are still known colloquially as steam rollers, regardless of their method of propulsion.

This typically only applies to the largest examples (used for road-making). Road rollers use the weight of the vehicle to compress the surface being rolled (static) or use mechanical advantage (vibrating). Initial compaction of the substrate on a road project is done using a pad foot drum roller, which achieves higher compaction density due to the pads having less surface area. On large freeways a four wheel compactor with padfoot drum and a blade, such as a Caterpillar 815/825 series machine, would be used due to its high weight, speed and the powerful pushing force to spread bulk material.

Dumper: Dumper is a vehicle designed for carrying bulk material, often on building sites. Dumpers are distinguished from dump trucks by configuration. A Dumper is usually an open 4-wheeled vehicle with the load skip in front of the driver, while a Dump Truck has its cab in front of the load. The skip can tip to dump the load, this is where the name "dumper" comes from. They are normally diesel powered. A towing eye is fitted for secondary use as a site tractor. Dumpers with rubber tracks are used in special circumstances and are popular in some countries.

Modern dumpers have payloads of up to 10 tonnes (11 short tons, 9.8 long tons) and usually steer by articulating at the middle of the chassis (pivot steering). They have multi-cylinder diesel engines, some turbocharged, electric start and hydraulics for tipping and steering and are more expensive to make and operate.



Fig : Photograph of Road Roller





Fig : Photograph of Dumper

Exercise: Assignment

1. List the models of Construction Equipment vehicles used in your area:

S.No.	Name of Model
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Observe and identify two types of Construction Equipment vehicles in your area and draw their diagrams:

3. Fill in the blanks:

- A road roller is a _____ type engineering vehicle used to compact soil, gravel, _____ or asphalt in the _____ of roads and foundations.
- Dumper is a vehicle designed for carrying _____.
- Dumper is a _____ vehicle.
- A Construction equipment vehicles are used for _____.
- Modern dumpers have payloads of up to _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Differentiate between Road Roller and Dumper.

Part B

Discuss in class the following:

- Role of Dumper.
- What are the different types of construction equipment vehicle?
- Why we use Road Roller?
- Why Bulldozer are used popularly.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw Construction Equipment Vehicles		
Able to distinguish between different Construction Equipment Vehicles		
Able to identify Construction Equipment Vehicles		

SESSION-5: SPECIAL VEHICLES

Relevant Knowledge

Automobile technology has several other applications also. We shall now get acquainted with some of these special applications. You would have all travelled by a Train. Railway locomotive is basically an automobile, but, much bigger than a car, bus or a truck. In the beginning trains were pulled by locomotives which were powered by steam. Now a days, most rail engines run on diesel fuel or electricity. In India, rail is a very



important means of transportation of goods and passengers. As you know that, a train cannot run on roads but runs on a railway track.

Many of you must have also seen big machines which have long extended arms for reaching high rise buildings or top of electric poles. These are mounted on an automobile and the complete machine is called a Crane. Some time you may have seen traffic police using a crane to lift cars which are wrongly parked.



Fig.: Railway Track



Fig.: Figure of Fork Lift



Another interesting application of an automobile is the Fork Lift. A fork lift is used mostly in industry and in large warehouses for carrying components and goods within the premises of the factory or the godown/ warehouse. So a fork lift is normally used for carrying goods for very short distances within the four walls of a building but never on the outside road.

When liquids like water, milk, oil, petrol, diesel etc are required to be transported to long distances, it is done in Tankers. These tankers have very big cylinders mounted horizontally on the chassis of a specially built automobile. Capacity of these tankers can vary.

Sometime, you may have seen the sign “flammable material”. This is a warning sign written on the tankers that carry volatile fluids like petrol & diesel. This warning is to caution people on the road that they should not bring any ignited object like match stick or fire crackers near the tanker. This is because petrol & diesel can catch



fire very easily since their flash point is very low and if there is any source of intense heat or ignited objects the tanker can catch fire and cause lot of damage.

It may be noted that sometimes these tankers are also mounted on railway trains. Also you may have seen pictures of tankers on a ship. Pictures of some of important special equipment such as fire brigade, trawler etc have been shown for your reference.



Fig : Photograph of Tanker



Fig : Photographs of Trawler

Exercise: Assignment

1. List the models of special vehicles used in your area:

S.No.	Name of Model
1	
2	
3	
4	
5	
6	

7	
8	
9	
10	

2. Observe and identify two types of Special Vehicle in your area and draw their diagrams:

3. Fill in the blanks:

- A train is pulled by _____.
- Train can not run on _____ but on a railway track.
- Crane is a _____ vehicle.
- When liquids like water, milk , oil , petrol, diesel etc are required to be transported to _____ distances, it is done in _____.
- Fire brigade vehicle is used for _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Differentiate between special vehicles.

Part B

Discuss in class the following:

- ❖ Role of special vehicles.
- ❖ What are the different types of cranes?
- ❖ Why we use tankers mostly?
- ❖ Why cranes are used popularly?

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw Special Vehicles		
Able to distinguish between different Special Vehicles		
Able to identify two Special Vehicles		

Suggested Reading

Books

Title	Author	Publisher
Automobile Engineering Vol I	Kirpal Singh	Standard Publishers
Automobile Engineering, Vol II	Kirpal Singh	Standard Publishers
Text Book of Automobile Engineering	R. K. Rajput	Laxmi Publications
Automobile Engineering	R. K. Singal	S. K. Kataria and Sons
Automobile Engineering Theory	Kapil Dev	Computech Publications
Automobile Engineering	K. M. Moeed	S. K. Kataria and Sons

Websites

- ❖ auto.indiamart.com/auto-technology
- ❖ www.automobileindia.com/consumer-guide/automobile-technology
- ❖ auto.indiamart.com/auto-technology
- ❖ books.google.com/books/about/Automobile_Engineering.html
- ❖ www.bikeadvice.org
- ❖ www.wikipedia.com

List of Contributors

1. Mr. Sunil K. Chaturvedi, CEO, Automotive Skills Development Council, Core 4-B 5th Floor India Habitat Centre, Lodhi Road, New Delhi – 110 003.
2. Mr. A.C. Deb, Sr. Lecturer, (Auto) – HOD, PUSA Polytechnic PUSA, New Delhi -110012.
3. Mr. Vikas Gautam, S.B.V. NO.1, Morigate, Delhi – 110006.
4. Prof. A.P. Verma, Ex-Prof. & HOD, PSSCIVE, Bhopal.
5. Sh. Deepak Shudhalwar, Assistant Professor, E & T Division, PSSCIVE, Bhopal.
6. Dr. Saurabh Prakash, Associate Professor, E & T Division, PSSCIVE, Bhopal – Programme Coordinator.

Unit-3

Major Systems & Components of an Automobile

Introduction

By now you are already familiar with an **Automobile**. Automobiles are made up of several components, assemblies and systems. The growing auto industry has given rise to a growing auto component industry also. India has emerged as global outsourcing hub for manufacturing of various automobile components. All major Companies like Toyota, Hyundai, Ford, Volvo, Renault and Daimler Chrysler and others are now sourcing their automotive components from Indian manufacturers.

The auto components industry is predominantly divided into five segments:

- Engine parts
- Drive Transmission & Steering Parts
- Suspension & Brake Parts
- Electrical Parts
- Body and chassis

Global automobile manufacturers see India as a manufacturing hub for auto components due to:

- Low cost labour force and availability of raw material which makes India cost competitive.
- India has an established manufacturing base.
- Major international auto-components including Delphi, Visteon, Bosch and Meritor have set up operations in India.
- Automobile manufacturers and auto component manufacturers have set up International Purchasing Offices (IPOs) in India.
- Fine-quality components are manufactured in India.
- India is a global hub for R&D: GM, Daimler Chrysler, Bosch, Suzuki, Johnson Controls etc. All have their research centre in India.

In this Unit, you will learn about various components and systems that makeup a complete automobile. Therefore you will be introduced to engine and its part, Body and chassis, Drive Transmission & Steering Parts, Suspension & Brake Parts, Electrical Parts and other systems that make it possible for running of an automobile.

SESSION-1: CHASSIS FRAME AND AUTO BODY

Relevant Knowledge

The Chassis

Chassis is a French term and was initially used to denote the frame or main structure of a vehicle.

The chassis contains all the major units necessary to propel the vehicle, guide its motion, stop it, and allow it to run smoothly over uneven surfaces. It is the main mounting for all the components including the body. It is also known as carrying unit.

The chassis includes the following major components:

1. Major part of a chassis is a steel frame.
2. In case of a passenger car the whole body is also an integral part of the chassis. However, in commercial vehicles like trucks & buses the body is not a part of the chassis. Therefore a chassis is almost a complete vehicle except body, other accessories which are not involved in the movement of the vehicle.
3. Other major components like Engine, Transmission System, Front & Rear Axle, Steering System, Suspension System, Wheels Tires & Brakes.

Functions of the chassis frame

1. To carry the weight of the vehicle and its passengers.
2. To withstand the engine and transmission torque and thrust stresses, as well as accelerating and braking torque.
3. To withstand the centrifugal force while cornering.
4. To withstand the bending loads and twisting due to the rise and fall of the front and rear axles.

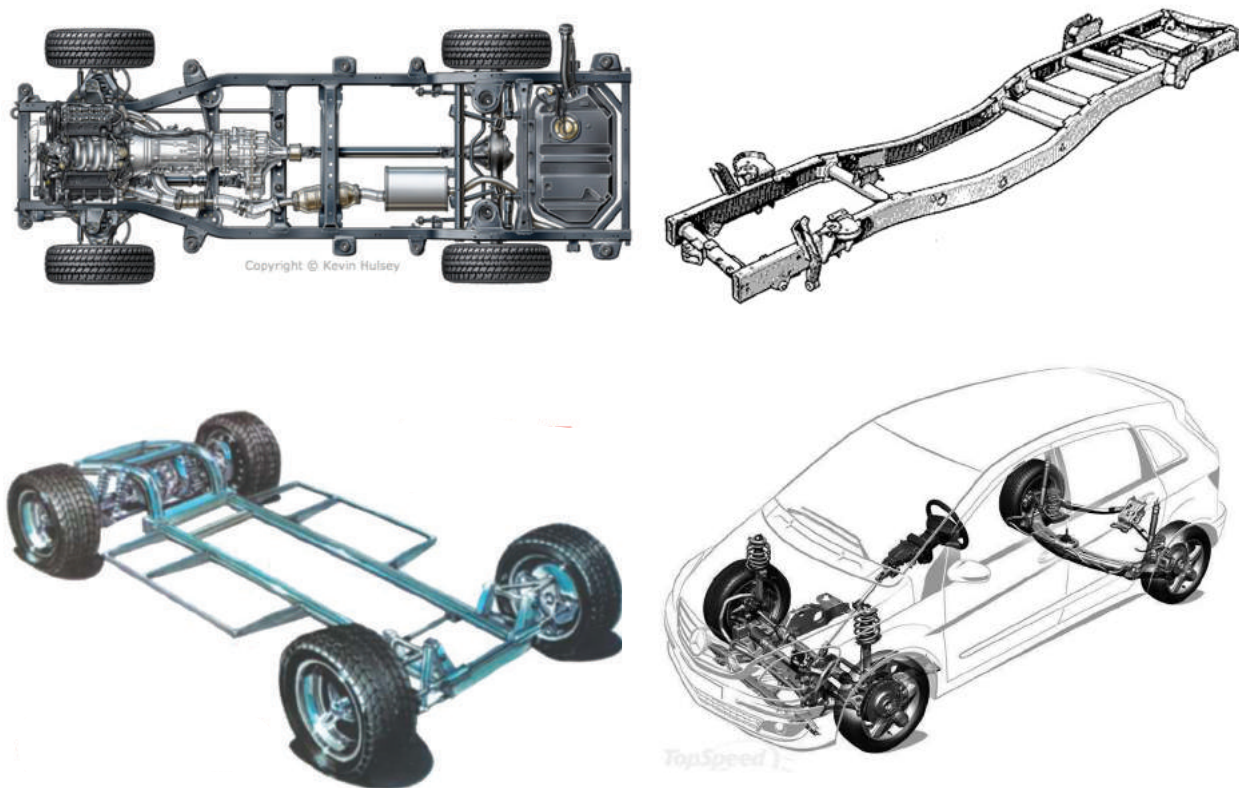


Fig: Diagram of different types of chassis frame

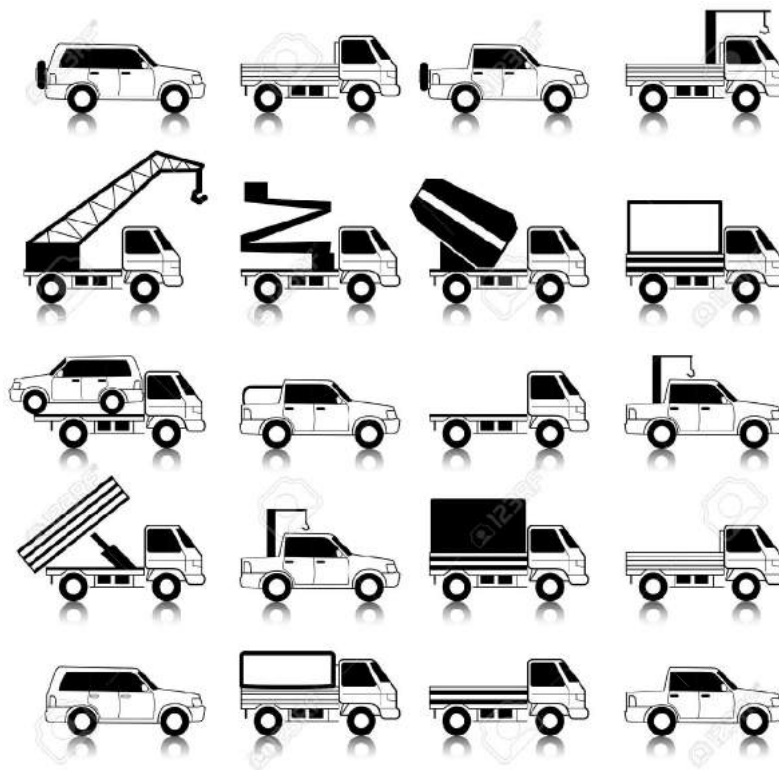


Fig. Different type of automobile body

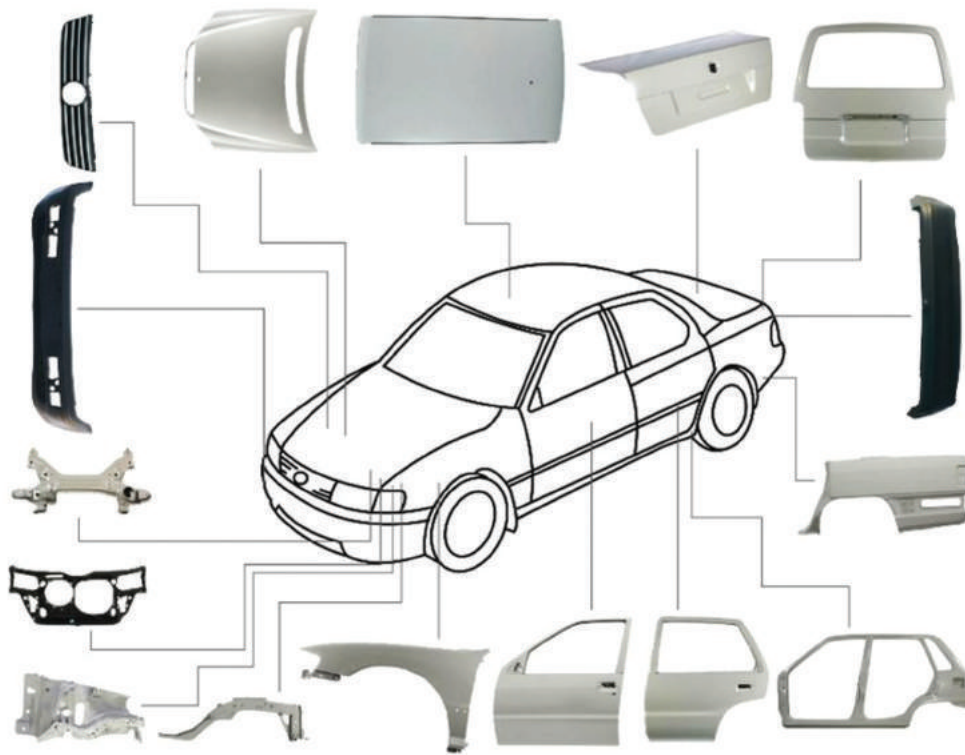


Fig. Parts of the Automobile vehicle



Fig : Frame of the body

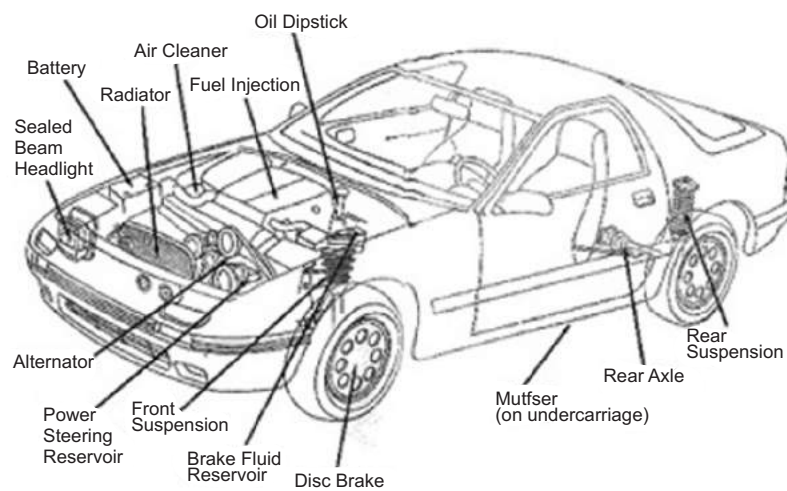
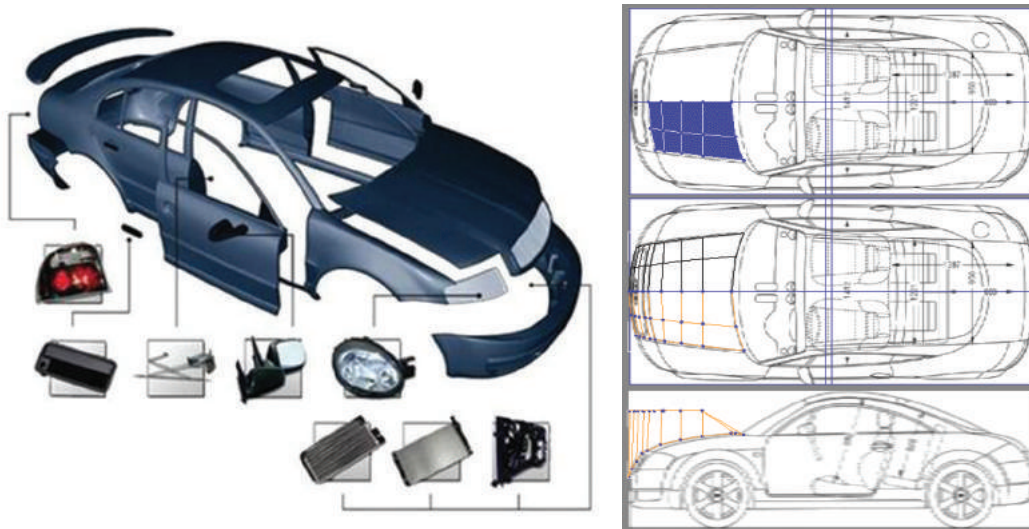


Fig. Components of a Vehicle



Fig : Photograph of a Complete Car

Auto body or superstructure

In case of integral or frameless construction the body is the integral part of chassis frame. But in case of the conventional chassis frame the body or superstructure is made after receiving the chassis from the manufacturer. The shape of the body depends upon the ultimate use for which the vehicle is meant.

Body is made of sheet metal or fiber glass, so that the passengers can sit in it. To make journey comfortable cushioned seats are provided. Body is provided on all sides with glass-panes fixed to protect the passengers from dust and rain. Bus bodies are mostly all metal bodies and can be either of (a) steel section pillars with steel sheet paneling, (b) steel section pillars with aluminum paneling, (c) all aluminum bodies, i.e., pillars, frame work and paneling are all made up of aluminum sections and sheets. This is because aluminum is very light in weight compare to steel. In the truck bodies only the driver's compartment is covered whereas the rest is kept open. Such bodies are usually called load bodies. In most of the cases, it is an open body, whereas for liquid material like water, milk and fuel products a tank is mounted on the chassis. The body is fixed to the chassis with the help of I or U-bolts with rubber packing placed between the chassis and body cross members as shown below:

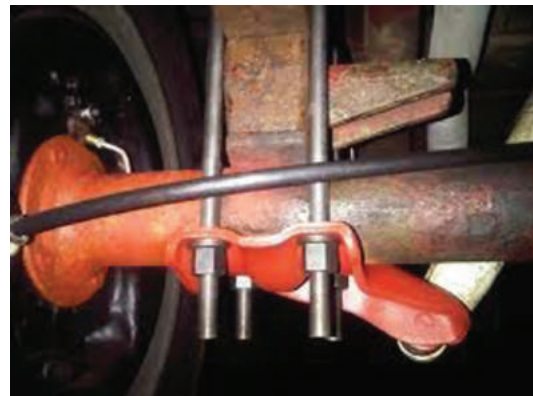


Fig. U bolt

Requirements of Automobile Body

The body of a motor vehicle should fulfill the following requirements:

1. The body should be light.

2. It should have minimum number of components.
3. It should have long fatigue life.
4. It should have uniformly distributed load.
5. It should provide sufficient space for passengers and luggage.
6. It should have good access to the engine and suspension system.
7. It should create minimum vibrations when the vehicle is running.
8. It should have minimum resistance to air.
9. It should be cheap and easy in manufacturing.
10. It should provide clear all-round vision through glass areas.
11. It should be attractive in shape and colour.

Exercise: Assignment

1. Name the component of chassis of a vehicle:

S.No.	Name of Model
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Observe and identify components of a car in your area and draw their diagrams:



3. Fill in the blanks:

- a) A chassis is almost a complete vehicle _____ body.
- b) The shape of the body _____ upon the ultimate use for which the vehicle is meant.

- c) Major part of a chassis is a _____ frame.
- d) In commercial vehicles like trucks & buses the body is not a _____ of the chassis.
- e) In most of the cases, it is an open body, whereas for liquid material like water, milk and fuel products a _____ is mounted on the chassis.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Differentiate between chassis frame and auto body.

Part B

Discuss in class the following:

- ❖ Functions of the chassis frame.
- ❖ Requirements of Automobile Body.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw a chassis and auto boy and its parts		

SESSION-2: ENGINE AND ITS COMPONENTS

Relevant Knowledge

Engine

Engine is heart of an automobile. Its role is very important. It converts the Chemical Energy (heat energy) to Mechanical Energy. This energy is utilized for vehicular movement. There are different ways of igniting fuel in an auto engine. Accordingly engines are called Internal Combustion (IC) OR external combustion Engines. Even within the IC engine category ignition can be by a spark or by high compression.

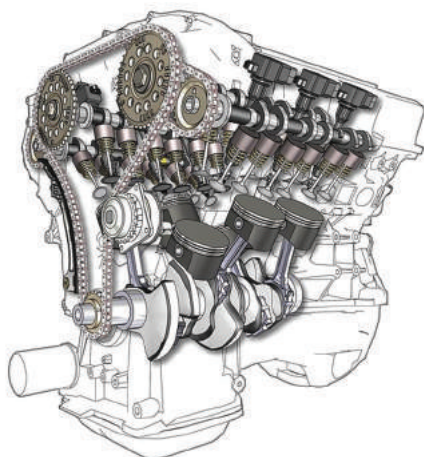


Fig : Engine assembly

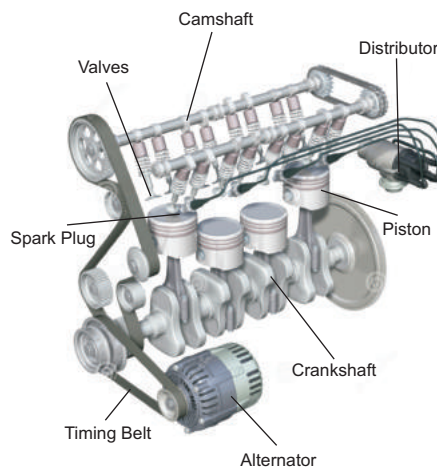


Fig. Some Engine components

Automotive engines are called internal-combustion (IC) engines because the fuel that runs them engine burned internally, or inside the engines. There are two types engines – reciprocating engine and rotary engine.

Reciprocating means moving up and down, or back and forth. Almost all automotive engines are of the reciprocating type. This type of engine is called a piston engine.

Rotary engines have rotors that spin, or rotate. Wankel has invented the Rotary engine, hence it is named as Wankel engine and these are slowly coming up in use today.

There are two kinds of piston engines (IC Engines).

1. Spark-ignition (Petrol or gas) engine.
2. Compression ignition (diesel) engine.

The differences between these two engines are:

- ❖ The type of fuel used.
- ❖ The way the fuel gets into the engine cylinders.
- ❖ The way the fuel is ignited.

The spark-ignition engine (petrol or gas engine)

The spark-ignition engine uses a highly volatile fuel which turns to vapor easily, such as gasoline or gasohol. The fuel is mixed with air before it enters the engine cylinders. The fuel turns into a vapor and mixes with the air to form a combustible air-fuel mixture. This mixture is then enters the cylinders and is compressed. Next, an electric spark produced by the ignition system to ignite the combustible mixture, which is already being compressed into the combustion chamber of engine.

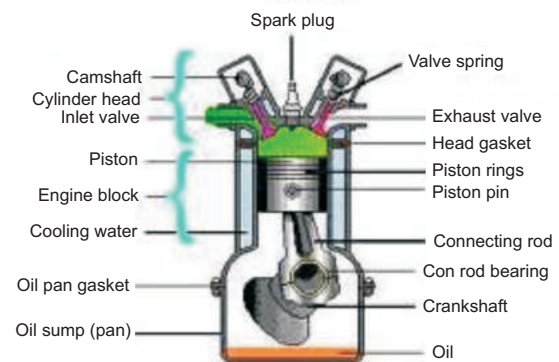


Fig. Ignition System

The compression-ignition (diesel engine)

In the compression-ignition engine or diesel engine, only fresh air enters the cylinder, which is then compressed to a very high temperature and pressure. The air is compressed so much that its temperature goes up to 10000F (5380C) or higher. Then the diesel is injected (sprayed) into the engine cylinder. This spray contains very very fine and tiny cloud of diesel known as atomized form in automobile jargon. The hot air, or heat of compression, ignites the fuel. This is why the diesel engine is called a compression-ignition engine.

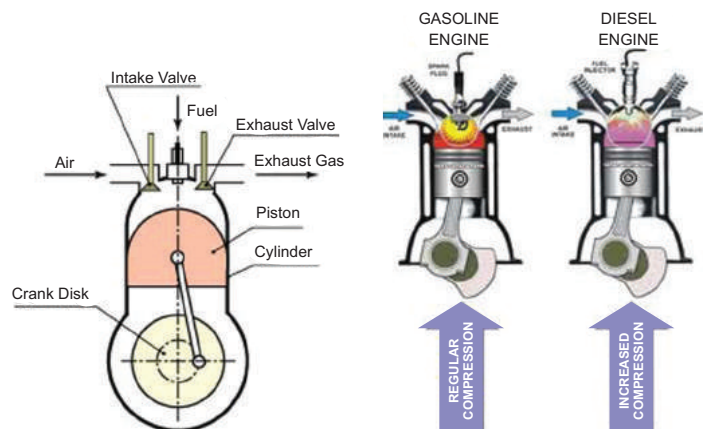


Fig: Ignition System

Components of I.C. engine

1. **Cylinder:** The cylinder of an I.C. engine is considered as the main body of the engine in which piston reciprocates to develop power. It has to withstand very high pressures (about 70 bar) and temperatures (about 2200°C) because there is direct combustion inside the cylinder. Therefore, its material should be such that it can retain strength at high temperatures, should be good conductor of heat and should resist to rapid wear and tear due to reciprocating parts. Generally, ordinary cast iron is used, but in case of heavy duty engines, alloy steels or aluminum alloy are used.
2. **Cylinder Head:** The cylinder head closes one end of the cylinder. It houses the inlet and exhaust valves. The charge (fuel and air mixture for SI engine and only air for CI engine) enters through inlet valves and after producing power the exhaust gases escape through the exhaust valves to the atmosphere.

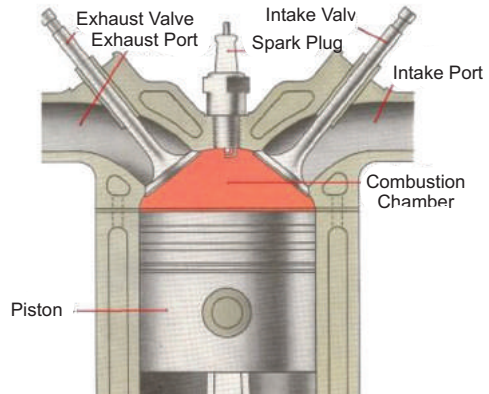


Fig.: Cylinder

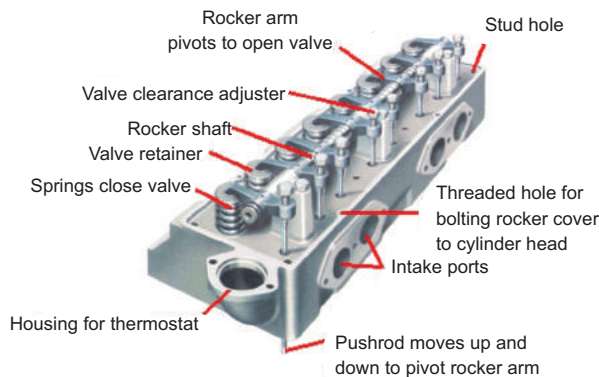


Fig : Cylinder Head Block



Cylinder head is usually cast as one piece and bolted to the top of the cylinder (engine block). A copper and asbestos gaskets are provided between the cylinder and cylinder-head to obtain a gas-tight joint. The material used for the cylinder-head is also cast iron or aluminum alloy.

3. **Piston and Piston Rings:** Piston is the heart of the engine. The functions of the piston are to compress the charge during compression stroke and to transmit the gas force to the connecting rod and then to the crank during power stroke. The pistons of I.C. engines are usually made of cast iron, cast steel and aluminum alloy. The aluminum alloy has the advantage of higher thermal conductivity and lower specific gravity.

The piston rings are housed in the circumferential grooves provided on the outer surface of the piston. It gives gastight fitting between the piston and the cylinder and prevents the leakage of high pressure gases. These are made of special grade cast iron. This material retains its elastic property at very high temperature. The upper piston rings are called the compression rings and the lower piston rings are called the oiling or oil control rings.

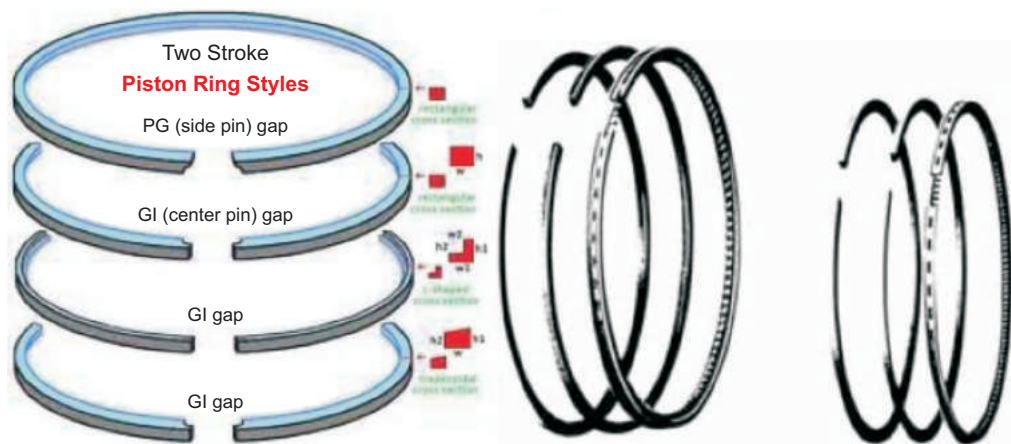
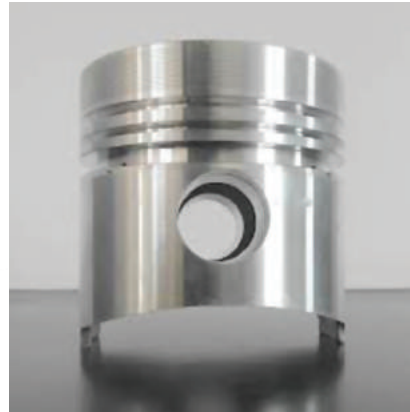
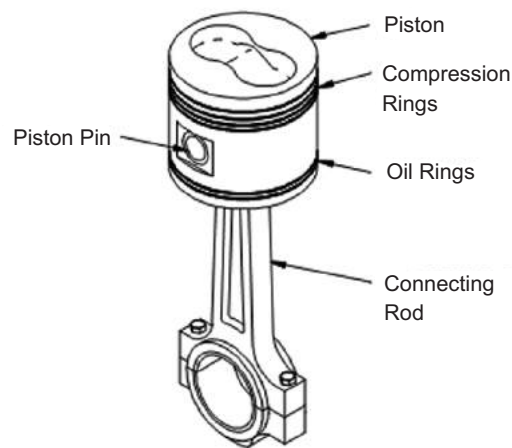


Fig: Piston Ring

4. **Connecting Rod:** It is usually a steel forging of circular, rectangular, I,T, or H section and is highly polished for increased strength. Its small end forms a hinge and pin joint with the piston and its big end is connected to the crank by crank pin. It has a passage for the transfer of lubricating oil from the big end bearing to small end bearing (gudgeon pin).

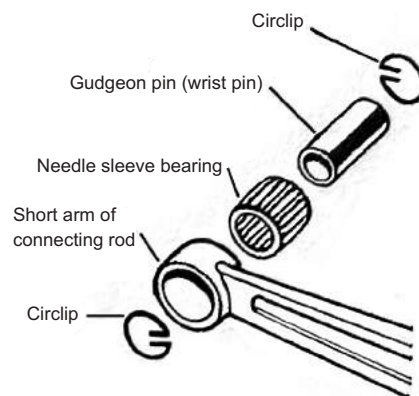


Fig : Connecting Rod

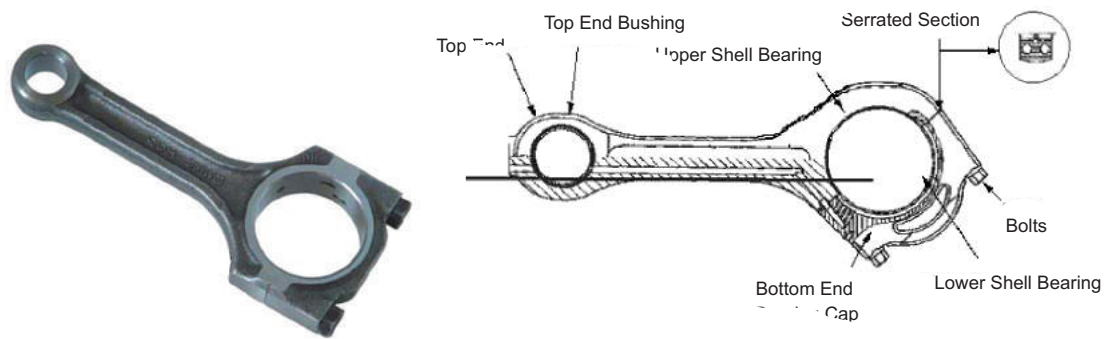


Fig : Connecting Rod

5. **Crank and Crankshaft:** Both crank and crankshaft are steel forged and machined to a smooth finish. The two are held together by means of a key. Crankshaft is supported in main bearings and has a heavy wheel, called flywheel, to even out the fluctuations of torque. The power required for any useful purpose is taken from crankshaft only. The crankshaft is the backbone of the engine.

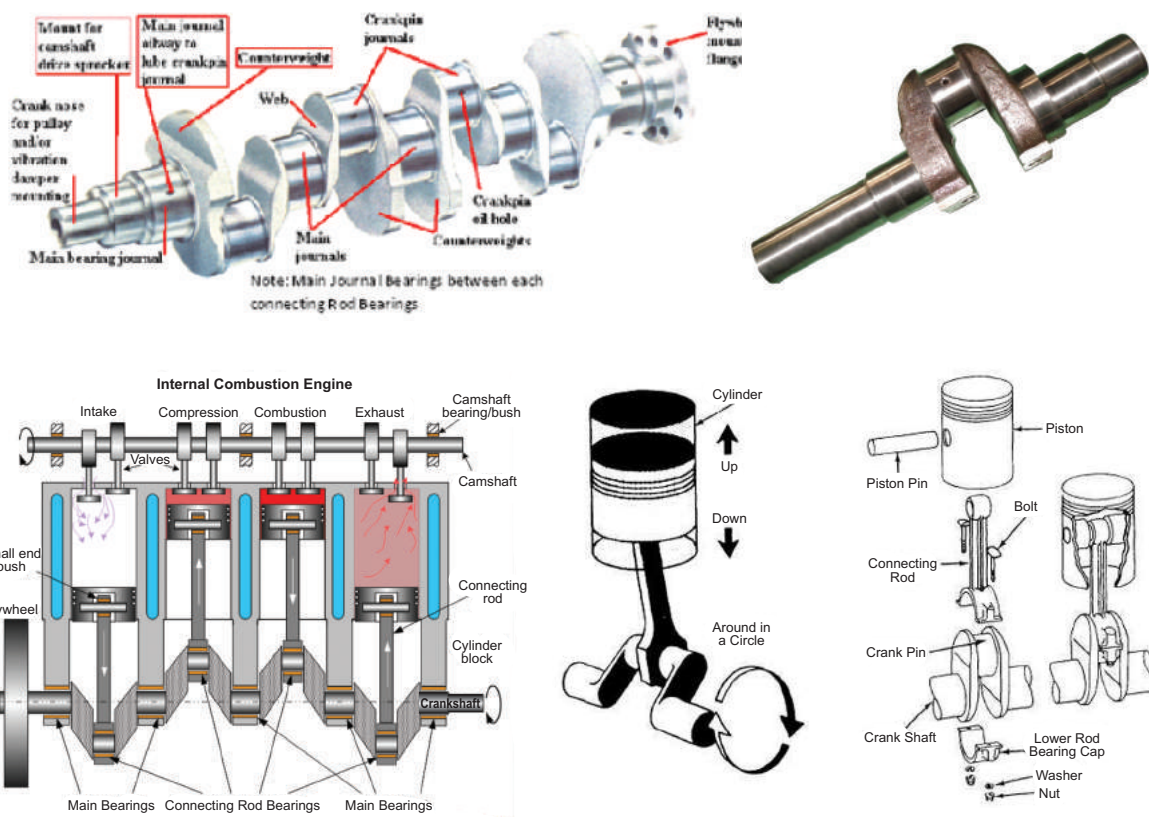


Fig: Crankshaft of multi cylinder engine

Fig: Crankshaft of single cylinder engine

6. **Piston Pin or Wrist Pin:** The piston pin provides the bearing for the oscillating small end of the connecting rod.

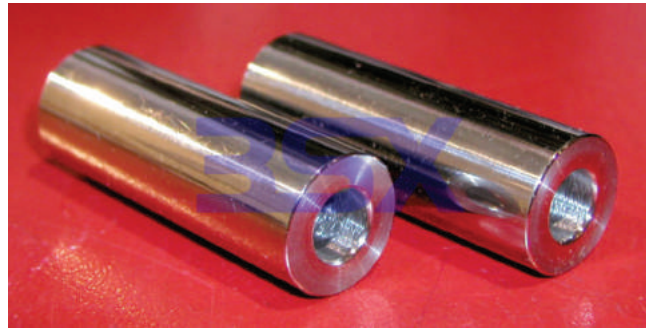
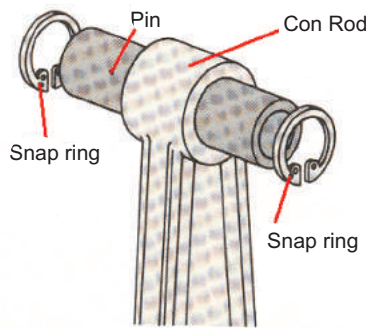


Fig : Piston Pin or Wrist Pin

7. **Inlet Valve:** This valve controls the admission of the charge into the petrol engine or air into diesel engine during suction stroke of the engine.

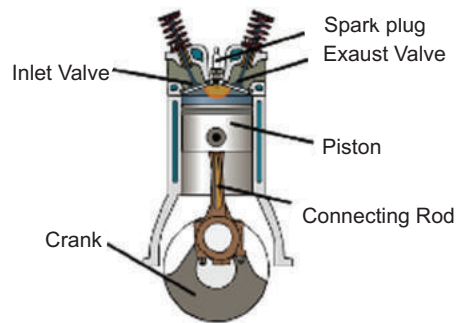


Fig : Inlet Valve

8. **Exhaust Valve:** The removal of exhaust gases after doing work on the piston, is controlled by this valve.
9. **Valve Spring:** The valves are kept closed by the valve springs.

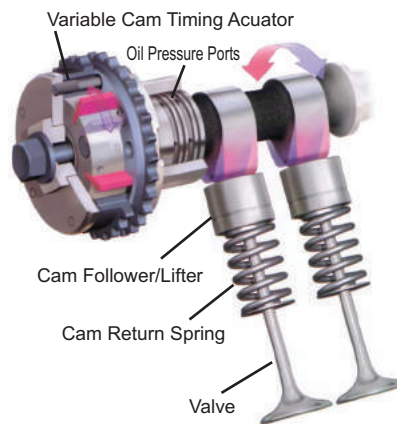


Fig: Valve Spring

10. **Inlet Manifold:** It is the passage which carries the charge from carburetor to the petrol engine or only air to the diesel engine.

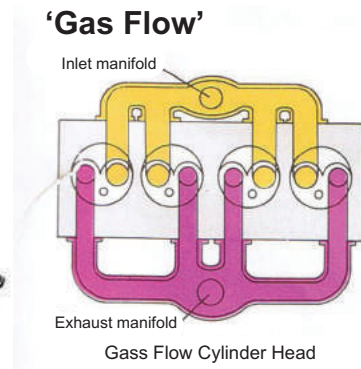


Fig : Inlet Manifold

11. **Exhaust Manifold:** It is the passage which carries the exhaust gases from the exhaust valve to the atmosphere.

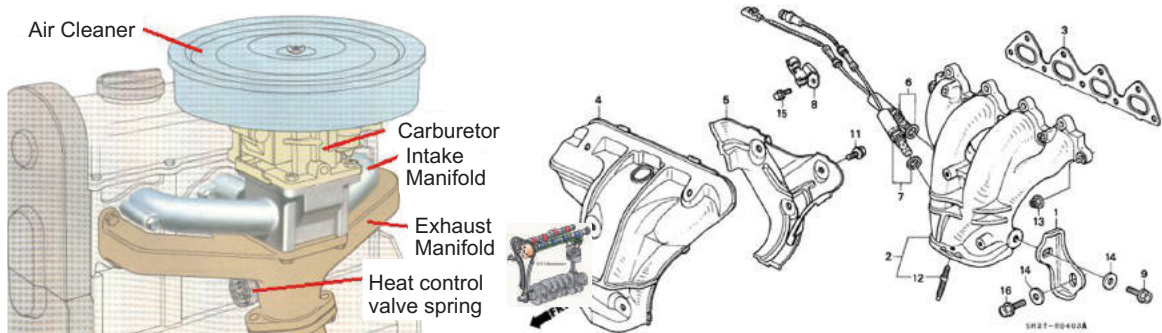


Fig : Exhaust Manifold

12. **Camshaft:** The function of the cam shaft is to operate the intake and exhaust valves through the cams, cam followers, push rods and rocker arms. The cam shaft is driven positively from the crankshaft at half the speed of the crankshaft.

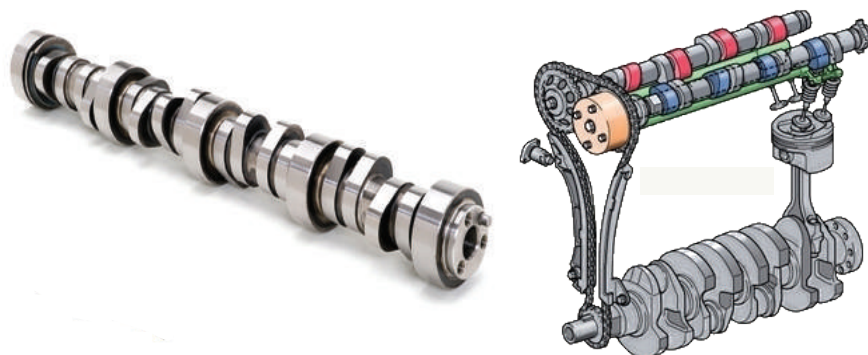


Fig : Camshaft

13. **Cam and Cam Follower:** It is made of a required profile to give desired motion to the valve through the follower.

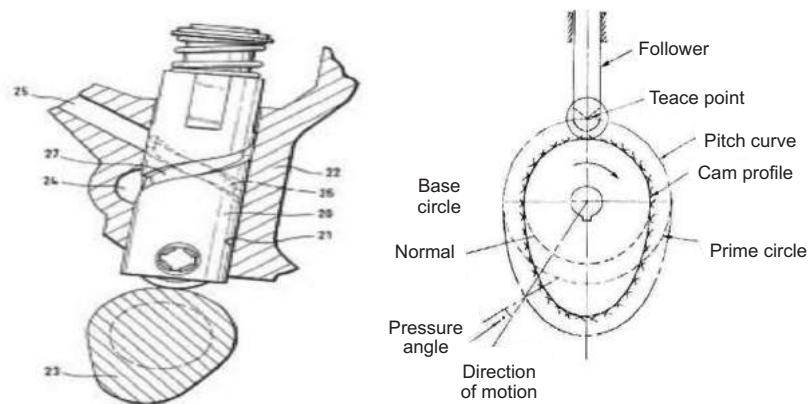


Fig : Cam and Cam follower

14. **Push Rod and Rocker Arm:** The motion of the cam is transmitted to the valve through the push rod and rocker arm. These links together are also known as valve gear.

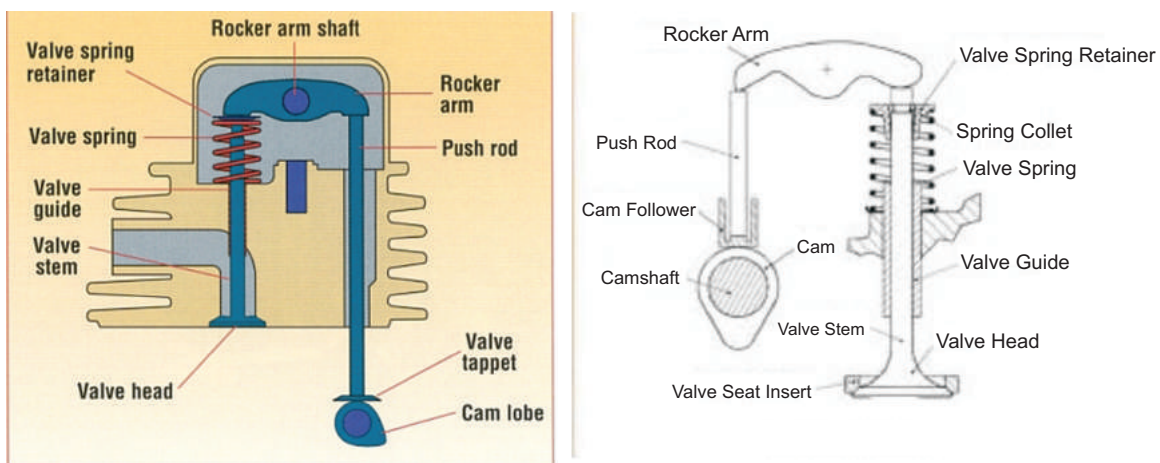


Fig : Push Rod and Rocker Arm

15. **Crank Case:** It is the base which holds the cylinder and crankshaft. It also serves as the sump for the lubricating oil.

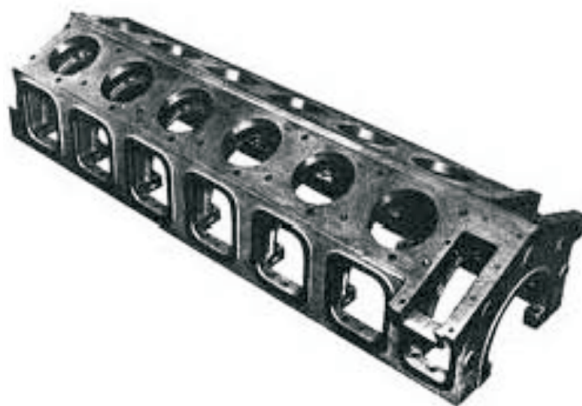


Fig : Crank Case

16. **Water Pump and Water Jacket:** The function of water pump is to draw water from the radiator and supply it to water jacket at certain pressure for the purpose of proper circulation of coolant between engine water jacket and radiator. The jackets are provided in the crankcase (cylinder block) for the circulation of coolant to carry away the excessive heat of the engine.

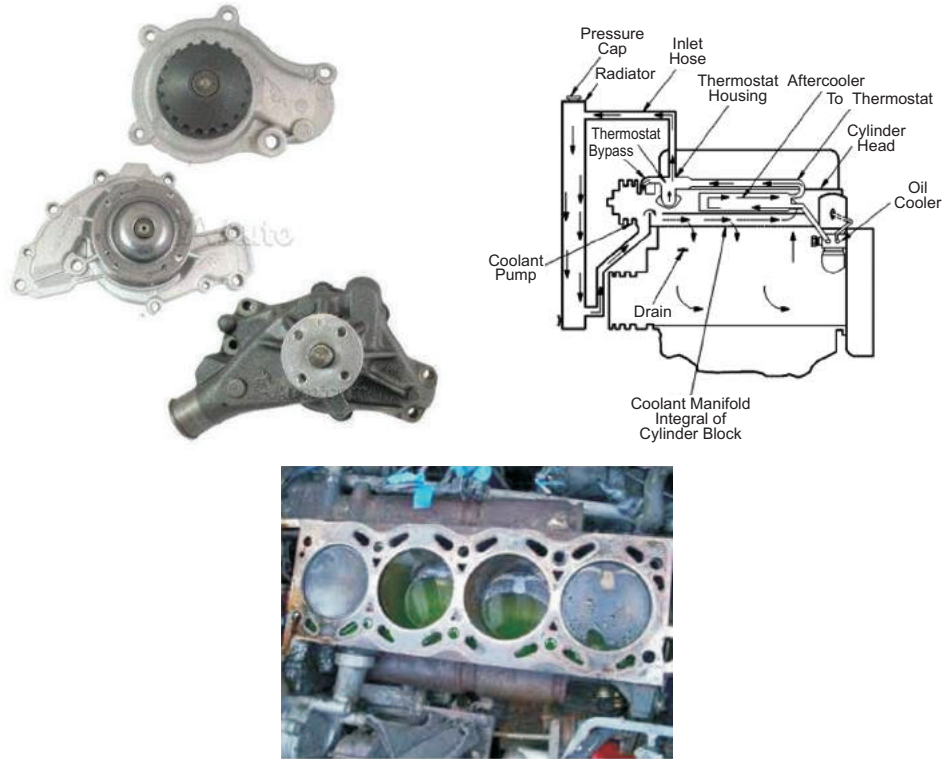


Fig : Water pump and Water Jacket

17. **Radiator:** It has two tanks located at top and bottom. It is the storage of coolant for cooling the engine. It has a pressure cap to increase the boiling point of coolant.



Fig : Radiator

18. **Bed Plate:** The lower portion of the crank case is known as bedplate. The bed plates are held by the bed bolts to concrete foundations.

19. **Flywheel:** It is a wheel mounted on the crankshaft which stores the energy during the power stroke and transmits the energy through transmission to the wheels when the clutch is engaged.



Fig: Fly Wheel

20. **Governor:** It is run by drive from the crankshaft. The function of the governor is to regulate the charge in case of petrol engine and amount of fuel in case of Diesel engine to maintain the speed of the engine constant, when the load requirement varies.

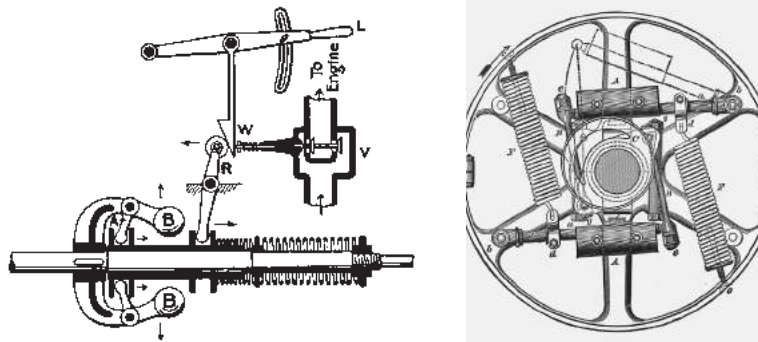


Fig: Governor

The components described above are commonly used for all types of IC engine. Here we are describing only few components which are used in a particular types of engines.

21. **Carburetor:** The function of the carburetor is to supply the uniform air-fuel to the cylinder of a **petrol engine** through the intake manifold. The mass of the mixture entering the cylinder is controlled by a special valve called as **throttle valve** will be described in later sessions.

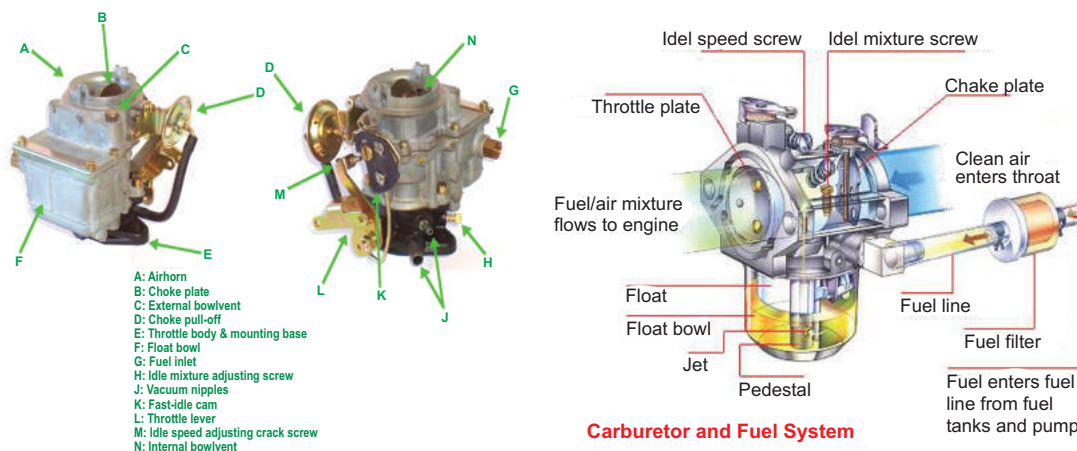


Fig : Carburetor

22. **Spark Plug:** The function of the spark plug is to ignite the mixture after completing the compression in the petrol engine. It is generally mounted in the cylinder head. This is only used in petrol engine.

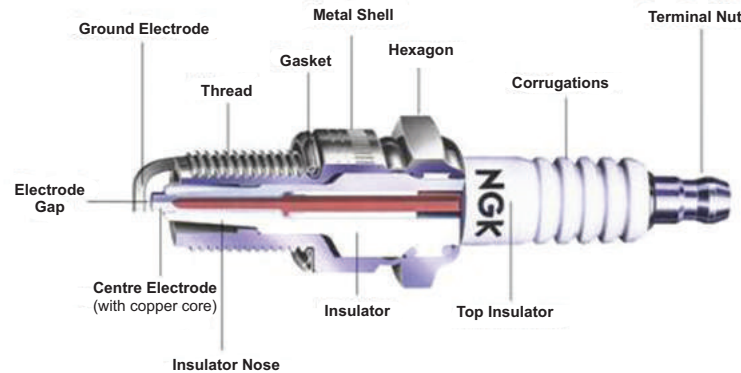


Fig : Spark Plug

23. **Fuel Injection Pump:** It forces the fuel oil at high pressure in atomized condition through fuel nozzle into the cylinder at the end of compression stroke in diesel engine.

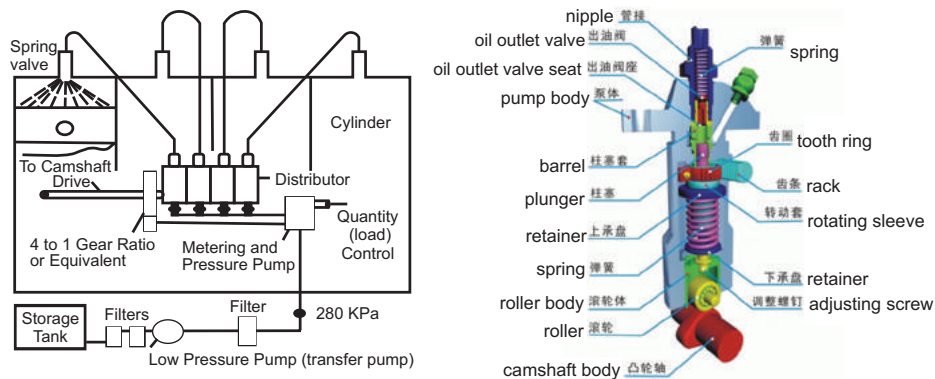


Fig : Fuel Injection Pump

24. **Fuel Injector:** The function of fuel injector is to break up the oil into fine spray (atomized condition) as it enters the cylinder of diesel engine.

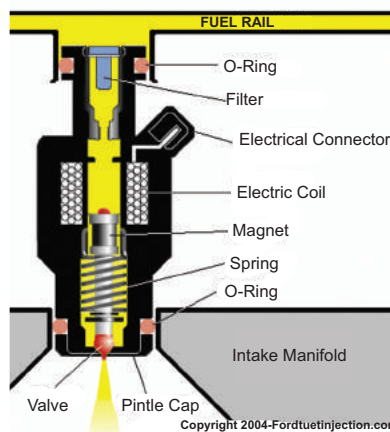


Fig : Fuel Injector

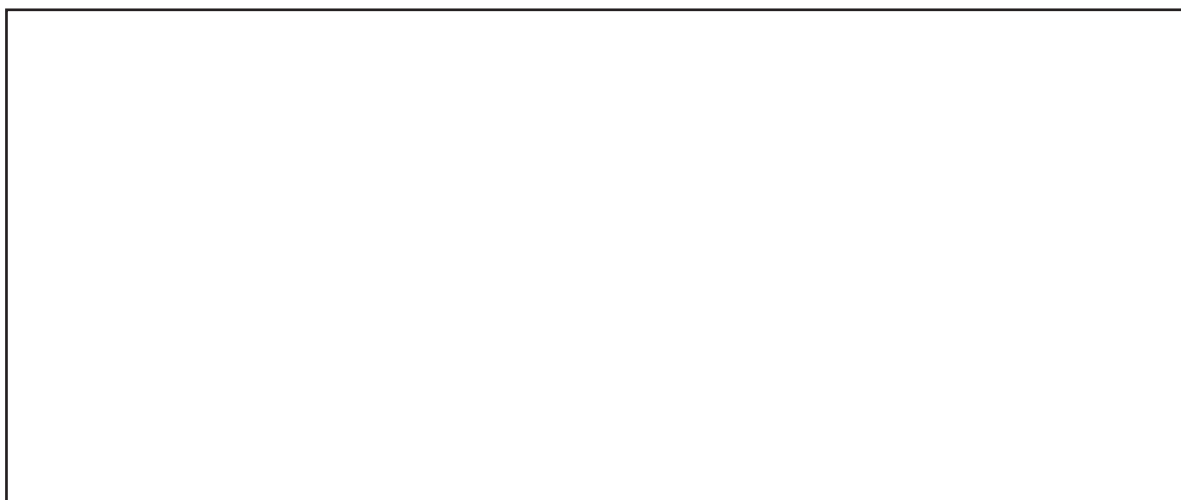
NOTE: Now a days fuel injectors are also used in spark ignition engine (in the inlet manifold) to spray petrol or gasoline in case of MPFI engines (all modern petrol engines).

Exercise: Assignment

1. Name the auto component system used in a vehicle:

S.No.	Name of Model
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Observe and identify engine in a workshop and draw their diagrams:



3. Fill in the blanks:

- a) Engine is _____ of an automobile. Its role is very important.
- b) Engine _____ the Chemical Energy (heat energy) to Mechanical Energy.
- c) Major parts of engine are _____, _____, _____, _____.
- d) The function of the carburetor is to supply the uniform _____ to the cylinder of a _____ through the intake manifold.
- e) Sparkplug is _____ used for _____.
- f) _____ It is a wheel mounted on the crankshaft which stores the energy.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Different components of an engine.

Part B

Discuss in class the following:

- Role of different components of an engine.
- Water pump and Water Jacket.
- Role of governor and carburetor.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw engine and label its parts		

SESSION-3: LUBRICATION SYSTEM

Relevant Knowledge

As you know that our body requires fluids like water and also oil in the form of fats like ghee, butter, cooking oil for maintenance of our system. Similarly lubrication is required for maintenance of engine. Lubrication circuit is one of the most important ones in the engine. The engine cannot run smoothly for more than a few minutes without the lubricating oil.

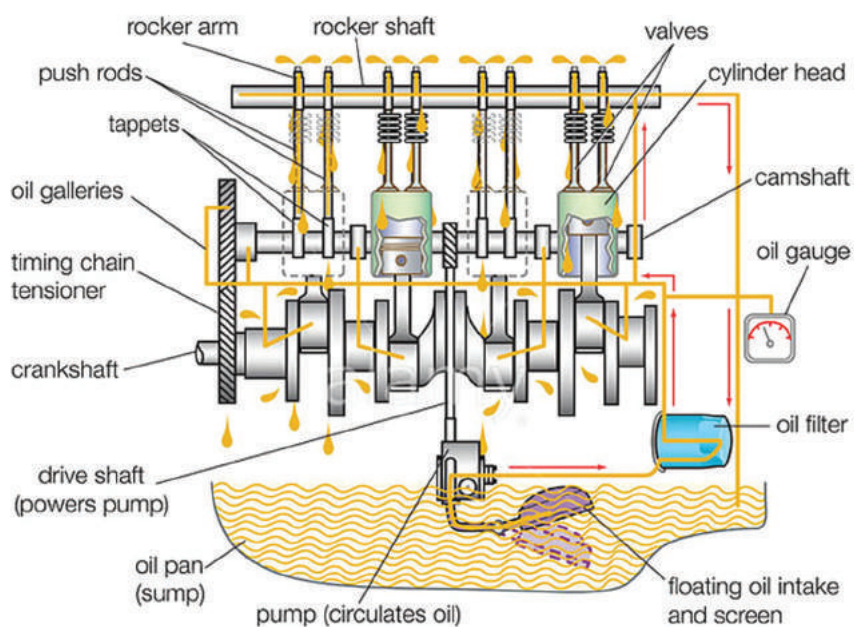


Fig: Lubrication system of the engine.

Whenever two metallic surfaces move over each other under direct contact, dry or solid friction is produced. This is due to the irregularities on the two surfaces interlocking each other. The dry friction thus created produces a lot of heat and results in wear of the metal surface.

Objective of Lubrication

The primary objective of lubrication are:

1. To reduce friction between moving parts to its minimum value so that power loss is minimized.
2. To reduce wear of the moving parts as far as possible.

Apart from these primary objectives, lubrication also serves other important purposes, which may be called secondary. These are as follows:

1. **To provide cooling effect** – The lubricating oil takes heat from the hot moving parts during its circulation and delivers it to the surrounding air through the crank case.
2. **To provide cushioning effect** – The lubricating oil serves also as a good cushion against the shocks experienced by the engine. For example, instant combustion of the fuel in the combustion chamber produces a sudden pressure rise in the cylinder and the shock goes to the bearings through the piston, gudgeon pin and the connecting rod. This shock is then absorbed by the layer of oil present in the main bearings.
3. **To provide cleaning action** – The lubricating oil serves another useful purpose in providing a cleaning action. During its circulation it carries away many impurities, e.g. carbon particles.
4. **To provide a sealing action** – The lubricating oil also helps the piston rings to maintain an effective seal against the high pressure gases in the cylinder from leaking out toward the crank case side.

Other than engine, lubricants are used for protecting following components also:

- ❖ Gear box
- ❖ Differential
- ❖ Steering gear box
- ❖ In different joints grease is used as lubricant.

Exercise: Assignment

1. List the important function of lubrication:

S.No.	Functions of lubrication
1	
2	
3	
4	
5	
7	
6	

8	
9	
10	

2. Observe and draw their diagram of lubrication system:



3. Fill in the blanks:

- Dry or solid frictions is produced in _____.
- Dry friction creates lot of _____.
- Objective of lubrication is to reduce _____.
- Lubrication provides _____ effect and _____ effect.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Importance of lubrication.

Part B

Discuss in class the following:

- ❖ Importance of lubrication in engine.
- ❖ Lubrications are used for various purpose.
- ❖ Lubrication is an essential component.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw figure of lubrication system of engine		
Able to identify components of lubrication system of engine		

SESSION-4: COOLING SYSTEM

Relevant Knowledge

Cooling System: As our body requires air and water for cooling our system similarly engine also requires cooling. The cooling system has three primary functions. These functions are as follows:

1. Remove excess heat from the engine.
2. Maintain a constant engine operating temperature.
3. Increase the temperature of a cold engine as quickly as possible by maintaining the thermostat valve in closed position which is fitted in the path of coolant circulation.

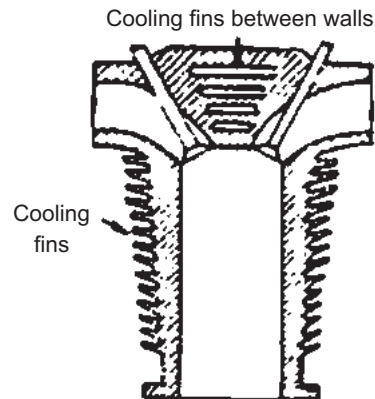
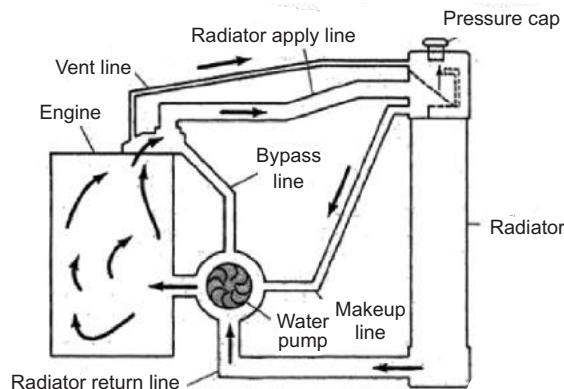
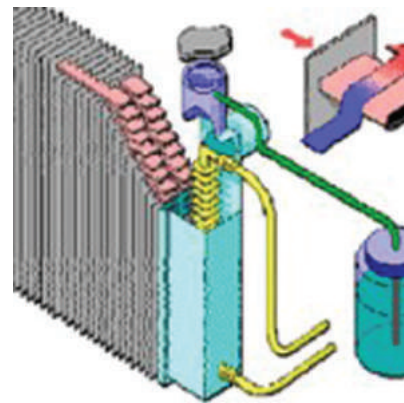
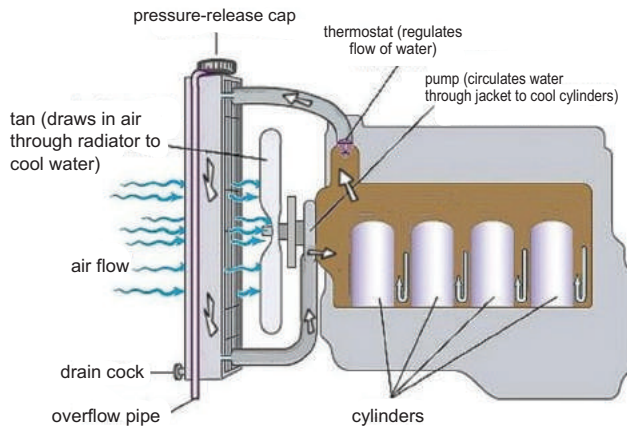


Fig: Cooling of Engine

Necessity of Cooling

The cylinders of internal-combustion engines require cooling because of the inability of the engine to convert all of the heat energy released by combustion into useful work. Liquid cooling is employed in most IC engines, whether the engines are for use in automobiles or elsewhere. The water (coolant) is circulated around the cylinders to pick up heat and then through a radiator to dissipate the heat. Usually a thermostat is located in the circulating system to maintain the design jacket

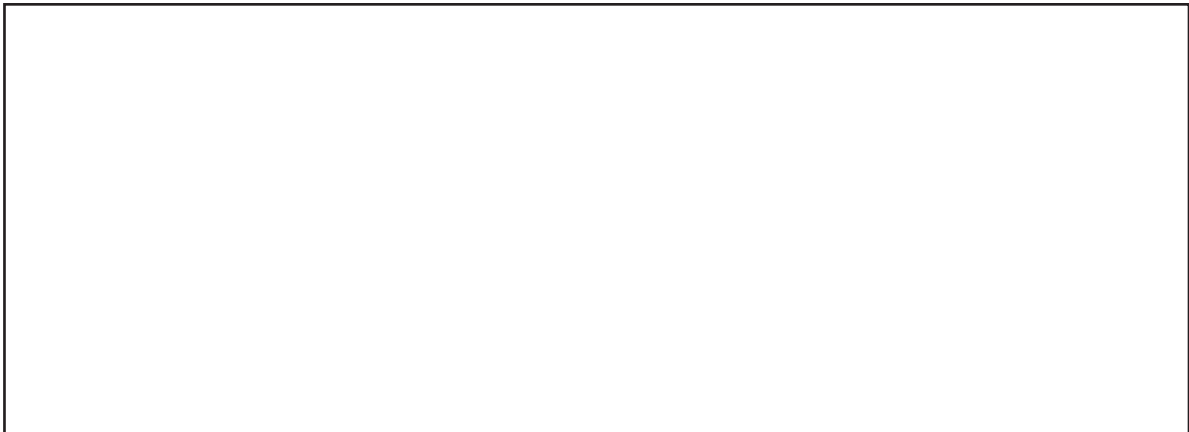
temperature – 710C to 820C. The cooling system is usually pressurized to raise the boiling point of the coolant with the help of a pressure radiator cap which increase the heat transfer capacity of the radiator.

Exercise: Assignment

1. List the important function of cooling system:

S.No.	Functions of Cooling
1	
2	
3	
4	
5	

2. Observe and draw the diagram of cooling system:



3. Fill in the blanks:

- a) Cooling system remove excess _____ from the engine.
- b) Cooling _____ a constant engine operating temperature.
- c) Objective of cooling is to reduce _____.
- d) Liquid cooling is employed in most _____ engines.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Importance of cooling system.

Part B

Discuss in class the following:

- ❖ Importance of Cooling in engine.

- ❖ Coolants are used for a purpose.
- ❖ Cooling system is an essential component.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw figure on cooling system of engine		
Able to identify the components of cooling system of engine		

SESSION-5: FUEL SUPPLY SYSTEM

Relevant Knowledge

Fuel Supply System

In petrol engines, the air and fuel is mixed outside the engine and partly evaporated mixture is supplied to the engine. The fuels such as petrol, benzol and alcohol used in S.I. engine, vaporizes easily if injected in the flow of air, therefore, the engine suction is sufficient to draw the mixture easily in to the cylinder.

The oil fuels which are used in C.I. engines do not vaporize easily. Therefore, a separate injection system is used consists of fuel injection pump (FIP) and injectors.

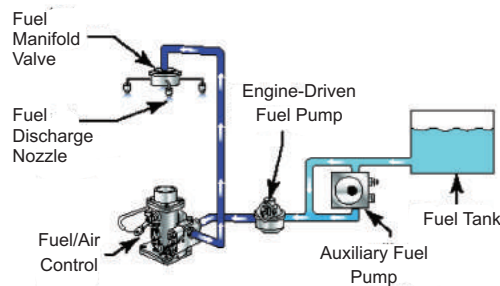


Fig: Fuel supply system for electronic injection

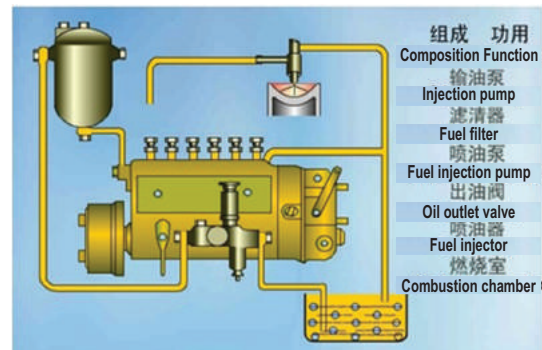


Fig: Conventional Fuel supply system for diesel engine

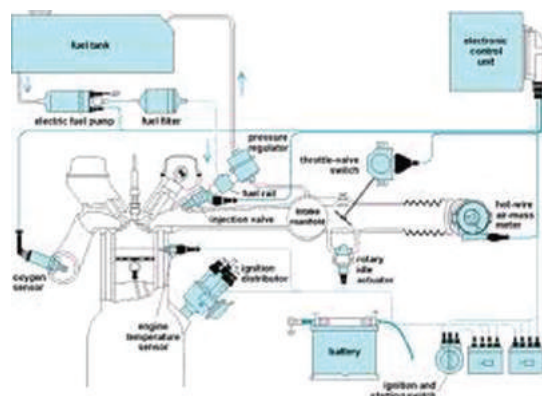
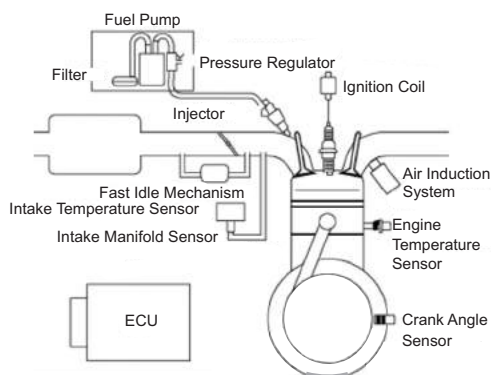


Fig: Fuel System

Fuel Supply Components For S.I. Engine	Fuel Supply Components For C.I. Engine
• Fuel tank • Fuel lines • Fuel pump (A.C. mechanical type or electrical type) • Fuel filter • Carburettor • Inlate manifold • Air cleaner Note: In case of modern MPFI engines carburetor is replaced by injectors and sensor.	• Fuel tank • Fuel lines • Fuel feed pump (Mechanical type or electrical type) • Fuel filters • Fuel injection pump (FIP) • Fuel injectors

Exercise: Assignment

1. List the important function of fuel supply system:

S.No.	Functions of fuel supply
1	
2	
3	
4	
5	

2. Observe and draw the diagram of fuel supply system:

3. Fill in the blanks:

- Air and fuel is _____ outside the engine and partly evaporated _____ is supplied to the engine.
- The fuels such as petrol, benzol and alcohol used in _____ engine.

- c) Suction is sufficient to draw the _____ in to the cylinder.
- d) Oil fuels which are used in C.I. engines do not _____ vaporize easily.
- e) Injection system used consists of fuel injection pump (FIP) and _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Importance of fuel supply system.

Part B

Discuss in class the following:

- ❖ Importance of fuel supply in engine.
- ❖ Fuels are used for a purpose.
- ❖ Fuel supply system is an essential component.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw figure on fuel supply system of engine		
Able to list the components of fuel supply system of engine		

SESSION-6: TRANSMISSION SYSTEM

Relevant Knowledge

Transmission system is used in motor vehicles, where the transmission systems supply the output of the internal combustion engine to the drive wheels. The transmission reduces the higher engine speed to the slower wheel speed, increasing torque in the process. Transmissions are also used on pedal bicycles, fixed machines, and anywhere else rotational speed and torque needs to be adapted.

Transmission System

The transmission system consists of following components.

1. Clutch assembly
2. Gear box assembly (transmission case assembly)
3. Propeller shaft

Clutch Assembly

Clutch is a mechanism which enables the rotary motion of one shaft to be transmitted, when desired. The axis of driving shaft and driven shaft are coincident.

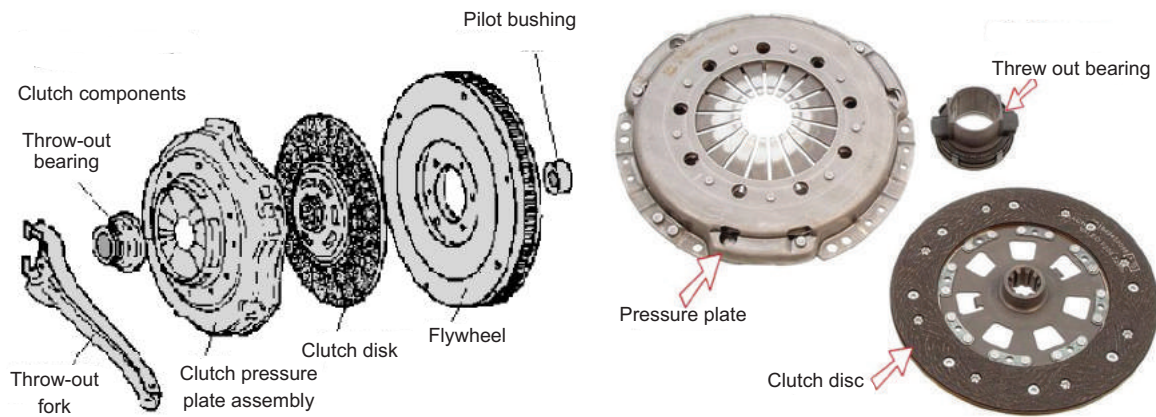


Fig : Different parts of Clutch Assembly

Function of a clutch

1. To disconnect the engine power from the gear box as required under following circumstances.
 - (a) To start the engine and warm it up.
 - (b) To facilitate to engage 1st and 2nd gear to start the vehicle from rest.
 - (c) To facilitate to change the gear as required.
 - (d) Disconnecting drive from the engine to stop the vehicle after application of brakes.
2. Allow the engine to take up load gradually without shock or jerk.

Requirements of a Clutch

1. **Torque transmission:** The clutch should be able to transmit maximum torque of the engine.
2. **Gradual engagement:** The clutch should engage gradually to avoid sudden jerks.
3. **Heat dissipation:** The clutch should be able to dissipate large amount of heat which is generated during the clutch operation due to friction.
4. **Dynamic balancing:** The clutch should be dynamically balanced. This particularly required in the case of high speed engine clutches.
5. **Vibration damping:** The clutch should have suitable mechanism to damp vibrations to eliminate noise produced during the power transmission.
6. **Size:** The clutch size should be as small as possible so that it will occupy minimum space.
7. **Free pedal play:** The clutch should have free pedal play in order to reduce effective load on the carbon thrust bearing and its wear.
8. **Easy in operation:** The clutch should be easy to operate requiring as little exertion as possible on the part of the driver.
9. **Lightness:** The driven member of the clutch should be made as light as possible so that it will not continue to rotate for any length of time after the clutch has been disengaged.

Main Parts of a Clutch

The main parts of clutch are divided into three groups:

1. **Driving members:** The driving members consist of a flywheel mounted on the engine crankshaft. The flywheel is bolted to a cover which carries a pressure plate or driving disc, pressure springs and releasing levers. Thus the entire assembly of the flywheel and the cover rotate all the times. The clutch housing and the cover provided with openings, dissipate the heat generated by the friction during the clutch operation.
2. **Driven members:** The driven member consists of a disc or plate, called the clutch plate. It is free to slide lengthwise on the splines of the clutch shaft (primary shaft). It carries friction materials on both of its surfaces. When it is gripped between the flywheel and the pressure plate, it rotates the clutch shaft through the splines.
3. **Operating members:** The operating members consist of a foot pedal, linkage, release bearing, release levers and the springs.

Gear Box (Transmission Case) Assembly

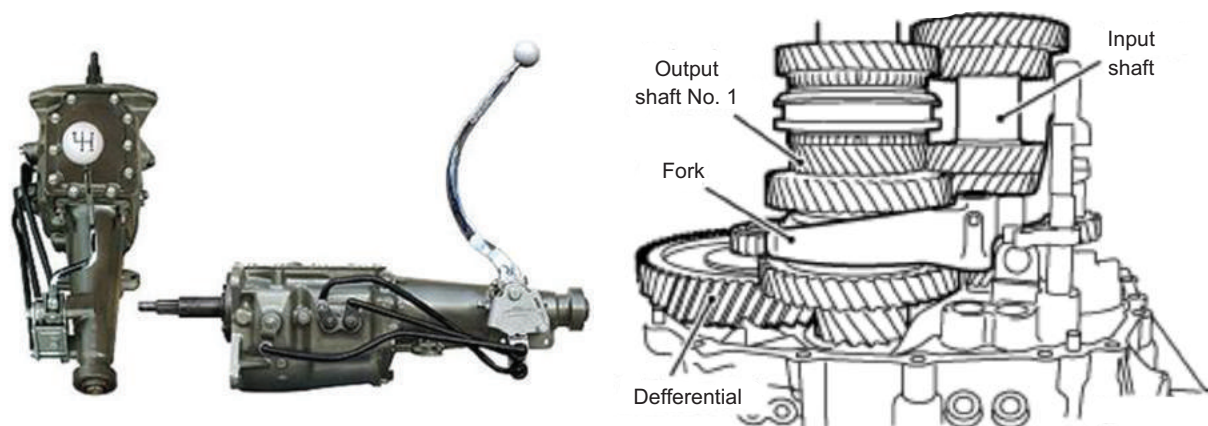


Fig : Gear Box and Gear

We need different gear ratios in the gear box or transmission system to enable the vehicle move in different speed. At the time of starting the vehicle, maximum amount of torque available on the fly wheel, for which low gear ratio has to be selected for the movement of the vehicle. As the engine speed increases the amount of torque is reduced in the fly wheel and it is required to select higher gear ratio.

Function:

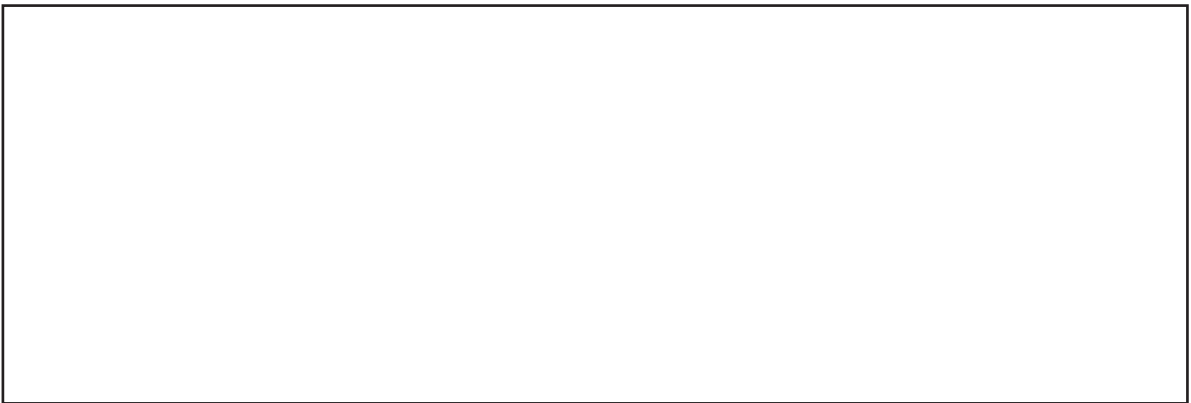
1. The main purpose of the gear box is to provide a means to vary the leverage or torque ratio between the engine and the road wheels as required.
2. The transmission also provides a neutral position so that the engine and the road wheels are disconnected even with the clutch in the engaged position.
3. A means to reverse the car by selecting the reverse gear.

Exercise: Assignment

1. Make a list of parts of clutch assembly used in the vehicle:

S.No.	List of parts of clutch
1	
2	
3	
4	
5	

2. Draw the photograph of clutch of a vehicle:



3. Fill in the blanks:

- a) Transmission system is used for _____.
- b) Main parts of clutch are _____, _____ and _____.
- c) Different gear ratios in the _____ to enable the vehicle move in different speed.
- d) Clutch main parts are _____, _____ and Operating members.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Discuss the role of transmission system.

Part B

Discuss in class the following:

- ❖ Why transmission is necessary?
- ❖ Role of clutch in transmission system.
- ❖ Function of gear box.
- ❖ Transmission system and its component.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to explain transmission system		
Able to identify the components of transmission system		

SESSION-7: FRONT AND REAR AXLE

Relevant Knowledge

For movement of a body of a car we need axle and steering system which transmit power to the wheel.

Propeller Shaft

This is the hollow tubular shaft which transmits the drive from the gear box to the bevel pinion of final drive. It consists mainly of three parts:

1. **Shaft:** As this has to withstand mainly torsional loads, it is usually made of tubular cross section. It also has to be dynamically balanced.
2. **One or two universal joints:** Depending upon the type of rear axle drive used. The universal joints account for the up and down movements of the rear axle when the vehicle is running.
3. **Slip joint:** Depending upon the type of drive, one slip joint may be there in shaft. This serves to adjust the length of the propeller shaft when demanded by the rear axle movements.

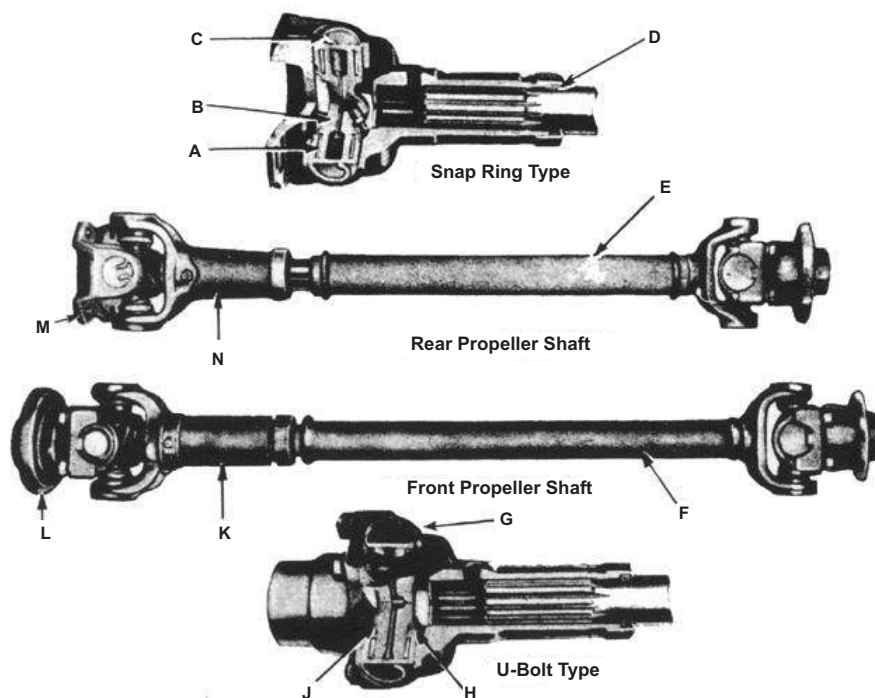


Fig : Propeller Shaft and Universal Joint

Front and Rear Axle

Front Axle

Front axle is usually a drop forging of steel. The axle has to take bending loads due to load of the vehicle and also torque loads due to braking of the wheels. For this reason, front axle is made of I-section in the central portion, while the ends are made either circular or elliptical.

A downward sweep is given to the centre portion to keep a low chassis height. Both the end of front axle are mounted with stub axles with the help of king pin. The front road wheels are mounted on stub axles.

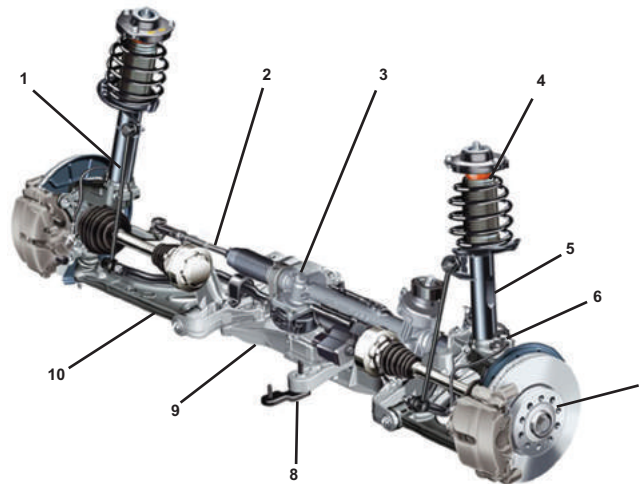


Fig: Front Axle

Rear Axle

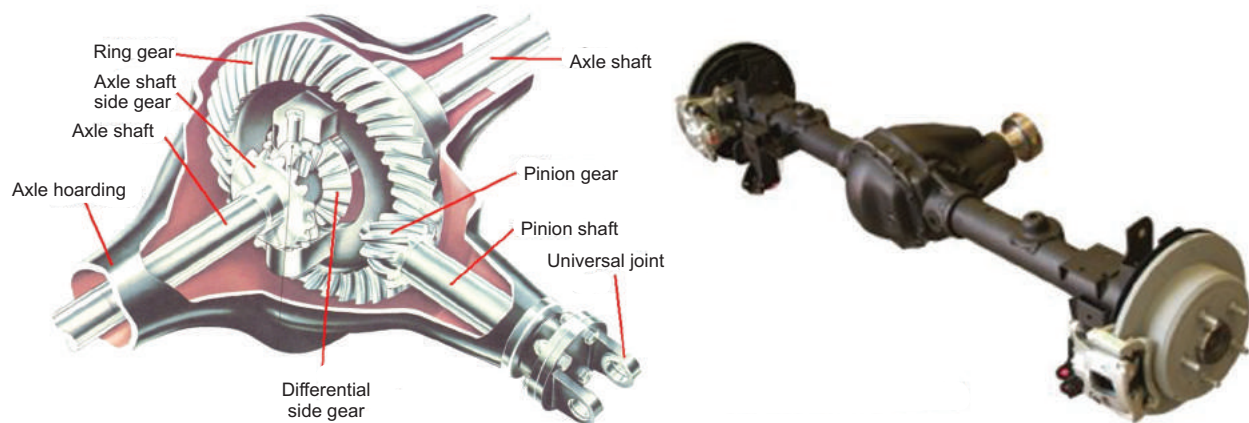


Fig: Rear Axle

The functions of rear axle are as follows:

1. It bears the weight of vehicle body and load due to occupants through springs.
2. It enables to transmit driving and breaking torque to the chassis frame and body of the vehicle.

3. It also experience the side thrust or pull due to any side load on the wheel.
4. It supports the bevel pinion (drive from propeller shaft transmit to the pinion), bevel gear, cage of sun gear and star pinions, axle shafts and different support bearings.
5. Rear road wheels are mounted on the axle shaft.
6. The differential mechanism enables to move outer wheel faster than the inner wheel while taking a turn.

Exercise: Assignment

1. Make a list of parts of front and rear axle used in the vehicle:

S.No.	List of parts of front and rear axle
1	
2	
3	
4	
5	

2. Draw the photograph of front and rear axle of a vehicle:



3. Fill in the blanks

- a) Front and rear axle system is used for _____.
- b) Main parts of front and rear axle are _____, _____ and _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Discuss the role of front and rear axle.

Part B

Discuss in class the following:

- ❖ Why front and rear axle is necessary?

- ❖ Role of front and rear axle in transmission system.
- ❖ Function of front and rear axle.
- ❖ Front and rear axle and its component.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to explain front and rear axle		
Able to identify the components of front and rear axle		

SESSION-8: STEERING SYSTEM

Relevant Knowledge

Role of Steering is to turn the front wheels using a hand-operated steering wheel which is positioned in front of the driver.

It consists of steering column, universal joints to allow it to deviate somewhat from a straight line.

Functions of Steering System:

1. It helps in swinging the wheels to the left or right.
2. It helps in turning the vehicle according to the will of the driver.
3. It provides directional stability.
4. It helps in controlling wear and tear of tyres.
5. It helps in achieving the self-straightening effect.
6. It converts the rotary movement of the steering wheel into an angular turn of the front wheels.
7. It multiplies the effort of the driver by leverage in order to make it fairly easy to turn the wheels.
8. It absorbs a major part of the road shocks thereby preventing them to get transmitted to the hands of the driver.



Rack and pinion steering mechanism:
1) Steering wheel 2) Steering column
3) Rack and pinion 4) Tie rod 5) Kingpin

Various components of steering system:

- ❖ Steering wheel
- ❖ Steering linkage with universal joint
- ❖ Drop arm
- ❖ Steering arm
- ❖ Ball joints
- ❖ Steering column
- ❖ Steering gear box
- ❖ Tie rod
- ❖ Track rod with adjuster
- ❖ Stub axle arm

Note: The steering system is fitted with the stub axle arm of front wheel with the help of ball joints.

Exercise: Assignment

1. Make a list of various components of steering system:

S.No.	List of components
1	
2	
3	
4	
5	

2. Draw the photograph of steering system of a vehicle:



3. Fill in the blanks:

- a) Steering system is used for _____.
- b) Main parts of steering system are _____, _____ and _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Discuss the role of steering system.

Part B

Discuss in class the following:

- ❖ Why steering system is necessary?
- ❖ Role of power steering system.
- ❖ Function of steering system.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to explain steering system		
Able to identify the components of steering system		

SESSION-9: SUSPENSION SYSTEM

Relevant Knowledge

Suspension is the term given to the system of springs, shock absorbers and linkages that connects a vehicle to its wheels. Suspension systems serve a dual purpose, contributing to the vehicle's road holding/handling and braking for good active safety and driving pleasure, and keeping vehicle occupants comfortable and reasonably well isolated from road noise, bumps, and vibrations, etc.

Importance of Suspension System

The main purposes of suspension system are as under:

1. To safeguard the occupants against road shocks and provide, riding comfort.
2. To minimize the effects of stresses due to road shocks on the mechanism of the motor vehicle and provide a cushioning effect.
3. To keep the body perfectly in level while travelling over rough uneven ground, i.e. the up and down movement of the wheels should be, relative to the body.
4. To isolate the structure of the vehicle from shock loading and vibration due to irregularities of the road surface without impairing its stability.
5. To provide the requisite height to body structure as well as to bear the torque and braking reactions.

Functions of a Suspension System

1. It provides comfort.
2. It gives cushioning effect.
3. It relieves strain on the frame and other components due to the road shocks.
4. It maintains body level and prevents it from rolling.
5. It provides a good contact for road holding, i.e. the system must always keep the tyres in contact with the road.
6. It transfers driving torque to the wheels as well as braking force to the chassis.

Various Components of Suspension System

Mechanical Suspension

- Leaf Springs
- Coil Springs
- Rubber Springs
- Torsion bars

Hydraulic Suspension

- Hydraulic Shock Absorber
- Telescopic fork

Air Suspension

Compressed air is used for air suspension system.

Exercise: Assignment

1. List the component of Suspension system:

S.No.	Name of component
1	
2	
3	
4	
5	

2. Draw the photograph of parts of suspension system of a vehicle:



3. Fill in the blanks:

- a) Propeller shaft is used for _____.
- b) Universal joint account for up and down movement of _____.
- c) Slip joints is used for _____.
- d) Front axle is used for _____.
- e) Rear axle helps in _____.
- f) Steering system help in swinging the wheels to the _____ or _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Discuss the suspension system.

Part B

Discuss in class the following:

- ❖ Role of suspension system?

- ❖ Function of suspension system.
- ❖ Component of suspension system.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw propeller shaft		
Able to identify the components of propeller shaft		

SESSION-10: WHEEL AND TYRE

Relevant Knowledge

Wheels and Tyre

The wheel is an important component of a vehicle. Wheel is assembly hub, disc or spokes, rim, tyre and tube. The wheels not only support the weight of the vehicle, but also protect it from the road shocks. All the four wheels must resist the braking stresses and withstand side thrust.

Functions the wheel

1. Strong enough to withstand the weight of the vehicle.
2. Flexible to absorb the road shocks.
3. Able to grip the road surface.
4. Perfectly balanced dynamically and statically.
5. Light and easily remarkable.

Rim: The rim is the "outer edge of a wheel, holding the tire." It makes up the outer circular design of the wheel on which the inside edge of the tire is mounted on vehicles such as automobiles. For example, on a bicycle wheel the rim is a large hoop attached to the outer ends of the spokes of the wheel that holds the tire and tube.

Different types of Wheel Rims

- ❖ Disc wheel rim.
- ❖ Wire spoke wheel rim (used in motor cycle, bicycle).
- ❖ Split wheel rim (used in scooter).
- ❖ Heavy vehicle wheel rim (available in three piece and four piece including locking ring).



Fig : Photograph of Rim



Fig : Photograph of Tyre

Tyre

The tyre is mounted on the wheel rim. It has to carry the vehicle load and provide a cushioning effect. It must produce a minimum noise, while the wheel is turning on the road. It resists the tendency for the vehicle to over steer. It should have good grip while accelerating and braking the vehicle on both the dry and wet roads.

Desirable Tyre Properties

A tyre must have the following desired properties:

1. **Non-skidding:** The tyre should not skid or slip on the road surface. It should have good grip.
2. **Uniform wear:** The tyre must get wear uniformly over its outer circumference.
3. **Load carrying:** The tyre should be able to carry the vehicle load.
4. **Cushioning:** The tyre should be able to absorb vibrations set-up by the road surfaces, thus providing cushioning effect.
5. **Power consumption:** While rooling on the road, the tyre should consume least power developed by the engine.
6. **Noise:** The tyre should create minimum noise while running on the road.
7. **Balancing:** The tyre should be balanced dynamically as well statically.

Function of Tyre

1. Carry the load of the vehicle.
2. Absorb the small road shocks.
3. Reduce the vibration to some extent.
4. Transmit the power from the engine through gearbox propeller shaft and rear axle to the ground with which the vehicle moves.
5. The treads made on the tyres grip the road for better traction.

Types of Tyre

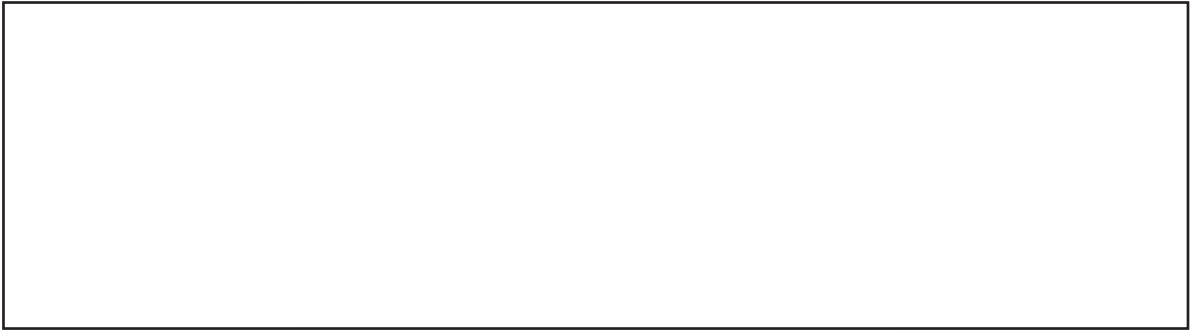
1. Solid Tyre (used in baby cycle).
2. Tube Tyre (used in almost all types of vehicles).
3. Tubeless tyre (used in modern cars).

Exercise: Assignment

1. List the different type of rim:

S.No.	Name of Rim
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Draw the photograph of wheel and rim of a vehicle:



3. Fill in the blanks:

- a) Wheel is used for _____.
- b) Properties of tires are _____, _____ and _____.
- c) Rim is used for _____.
- d) Tube is used for _____.
- e) Rim is outer edge of _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Discuss the wheel and tyre

Part B

Discuss in class the following:

- 1. Role of wheel and tyre.
- 2. Function of wheel.
- 3. Component of wheel.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw wheel and tyre		
Able to identify the components of wheel and tyre		

SESSION-11: BRAKE

Related Knowledge

Brake: Brakes are one of the most important control components of a vehicle. They are required to stop the vehicle within the smallest possible distance and this is done by converting the kinetic energy of the wheels into the heat energy which is dissipated into the atmosphere.

Functions of Brakes

There are two distinct functions of the brakes:

1. To stop or slow down the vehicle in the shortest possible distance in emergencies.
2. To control the vehicle speed while moving on plain roads and hills.

Requirements of a good breaking system

1. The brakes should stop the vehicle in shortest possible distance and time.
2. The brakes should work equally well on fair or bad roads.
3. Pedal effort applied by the driver should not be more so as not to strain the driver.
4. Brakes should work equally well in all weathers.
5. It should have very few wearing parts.
6. It should require little maintenance.
7. Brakes, when applied should not disturb steering geometry.
8. There should be minimum sound when brakes are applied.

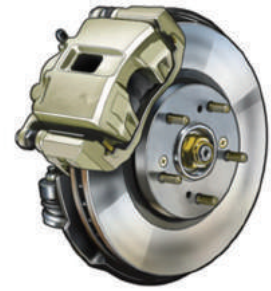


Fig : Brake

Types of Brakes

1. With respect of application:
 - (a) Foot brake
 - (b) Hand brake
2. With respect to the method of braking contact:
 - (a) Internal Expanding brakes
 - (b) External contracting brakes (e.g. disc brakes of automobile and railway brakes)
3. With respect to the brake gear:
 - (a) Mechanical brakes
 - (b) Power brakes
4. With respect to the nature of power employed:
 - (a) Vacuum brakes
 - (b) Air brakes
 - (c) Hydraulic brakes
 - (d) Hydraulic brake assisted with air
 - (e) Hydrostatic brakes
 - (f) Electric brakes

Exercise: Assignment

1. List the different types of brakes used in automobile:

S.No.	Types
1	
2	
3	
4	
5	

2. Draw the photograph of brake of a vehicle:



3. Fill in the blanks:

- a) Brakes are used for _____ component of a vehicle.
- b) Tubes are used for _____.
- c) Functions of a brake is _____ or _____ vehicle.
- d) Brake should work in _____ or _____ roads.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Role of brake

Part B

Discuss in class the following:

- ❖ Importance of brake in the automobile.
- ❖ Brake for the automobile.
- ❖ Properties of good brake system.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw the brake		
Able to identify different type of brake.		

SESSION-12: ELECTRICAL AND ELECTRONIC SYSTEM

Relevant Knowledge

It is a very important system of a car as now days all the automobile vehicles are running with the help of electrical and electronic system.

Electrical and Electronics System

The electrical and electronic system consists of following:

- ❖ **Starting System:** The starting motor is driven by means of the current taken from the battery.
- ❖ **Ignition System:** The function of the ignition system is to produce a spark in the engine combustion chamber at the end of the compression stroke.
- ❖ **Generating or Charging System:** The function of the charging system in an automobile is to generate, regulate and supply the electrical energy for charging the battery.
- ❖ **Lighting System:** It consists of various types of lighting used during the vehicle running, such as head light, tail light, fog light, brake light, reversing light, left and right indicators, parking light, cabin light, panel board lights, etc.
- ❖ **Connections for other accessories:**

Main Component of the Electrical System

Starting System	Generating or Charging System	Ignition System	Lighting System	Accessories
• Battery • Starting Motor • Motor Control	• Generator/ Alternator • Ammeter • The cut-out • Switch • The battery • Voltage and current regulator	• Battery • Ignition switch • Ignition coil • Distributor • Spark plugs • Contact breaker • Automatic advance and retard unit • Vacuum control unit	• Head light • Side light • Rear light • Fog Lamps • Number plate illumination lamp • Interior lights • Indicator flashers	• Horns • Wind screen wiper • Electric fuel pump • Fuel gauges • Temperature gauge • Radio sets • Cigar lighter/mobile phone charger • Heater • Wind screen defroster • Signaling devices

NOTE: In modern vehicles various types of electronic sensors and actuators are fitted in different system of the engines, which are also operated electrically.

Exercise: Assignment

1. List the different component using electrical and electronic system:

S.No.	List of component
1	
2	
3	
4	
5	

2. Draw the photograph of electrical items of a vehicle:

3. Fill in the blanks:

- a) Electrical system are used for _____.
- b) Electronic system help _____ a vehicle.
- c) Charging system is used for _____ vehicle.
- d) Important accessories used in vehicle having electrical system are _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Role of Electrical and Electronic System.

Part B

Discuss in class the following:

- ❖ Importance of electrical and electronic system in the automobile.
- ❖ Components using electrical and electronic system.
- ❖ Advantages of electronic system.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to explain the advantages of electrical & electronic system		

SESSION-13: AIR CONDITIONING SYSTEM

Relevant Knowledge

Automobile Air Conditioner

During summer, an automobile requires considerable amount of refrigerating capacity to maintain cool comfort conditions in the sitting space. Similarly when moving in a cold day in winter, the same vehicle would require considerable heating capacity to keep it comfortably warm for passengers.

Modern day automobiles have an air conditioning unit to maintain suitably controlled temperature and humidity conditions inside the vehicle. An air conditioner is a refrigeration machine requiring electrical energy. In automobiles its air conditioner draws energy from the battery system. The battery of course is charged by energy of the engine.

For heating purposes, the warm water from the engine cooling system is used. The heat required to warm the automobile is generally provided by circulating warm water through a heating coil.

The air conditioner also serves to clean the air along with the control of temperature level. During summer days humidity of the air inside the vehicle is reduced with air-conditioner in operation. This results in creating comfortable conditions inside the automobile.

Car air conditioner comes inbuilt in the car and same can be fitted in car also.



Fig : Air Conditioner in Car

Different components of Automobile Air-conditioning system

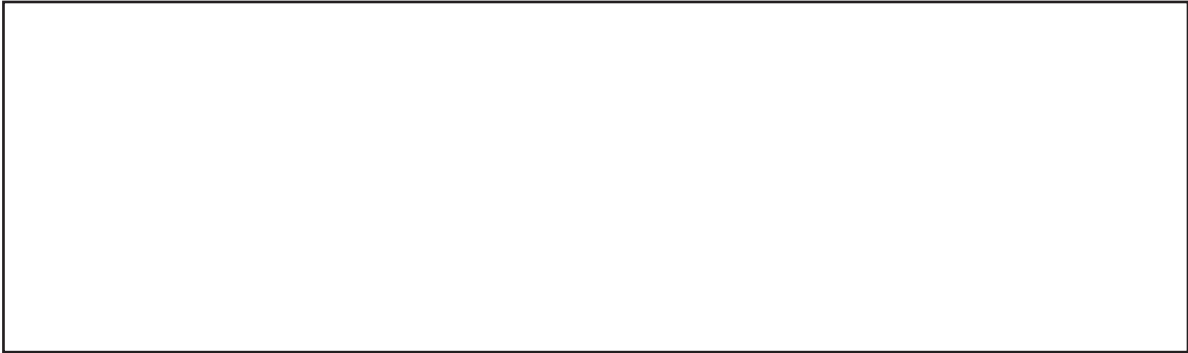
- ❖ Compressor
- ❖ Magnetic Clutch
- ❖ Condenser
- ❖ Receiver-driver (or dehydrator)
- ❖ Expansion valve
- ❖ Evaporator
- ❖ Suction throttling valve

Exercise: Assignment

1. List the different component of air conditioning system:

S.No.	List of component
1	
2	
3	
4	
5	

2. Draw the photograph of air conditioner of a vehicle:



3. Fill in the blanks:

- a) Air conditioning system are used for _____.
- b). Air conditioning system help _____ in a vehicle.
- c) Passive safety helps in _____.
- d) Active system is used for _____ vehicle.
- e) Important accessories used in vehicle having air conditioning system are _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Role of Air Conditioning System.

Part B

Discuss in class the following:

- ❖ Comfort used by active and passive safety.
- ❖ Components of air conditioning system.
- ❖ Advantages of air conditioning system.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to explain the advantages of Air Conditioning system		

SESSION-14: ACTIVE & PASSIVE SAFETY

Relevant Knowledge

Active and Passive Safety and Security Systems

There are different safety and security systems are available in the market and some of which are fitted by the manufacturer. Following are the few active and passive security systems.

Safety Glass

Safety glass is used in all auto windows and doors. The safety glass employed in today's vehicles is of two types: laminated or tempered. These types are considered to be safety glass because of their construction.

Laminated plate glass is used to make all wind shields. This type of glass consists of two thin sheets of glass with a thin layer of clear plastic between them. Some glass manufacturers have increased the thickness of the plastic material for greater strength. When this type of glass is broken, the plastic material will tend to hold the shattered glass in place and prevent it from causing injury.

Tempered glass is used for side and rear window glass but rarely for windshields. This type of glass is a single piece of heat-treated glass and has more resistance to impact than regular glass of the same thickness.

Seat Belts

A seat belt, sometimes called a safety belt, is a safety harness designed to secure the occupant of a vehicle against harmful movement that may result during a collision or a sudden stop.

A seat belt reduces the likelihood and severity of injury in a traffic collision by stopping the vehicle occupant from hitting hard against interior elements of the vehicle or other passengers, by keeping occupants positioned correctly for maximum benefit from the airbag.

In most vehicles the passenger must fasten the seat belt for crash protection. The passive safety system operates automatically whenever there is an accident. No action is required of the occupant to make it functional.

In modern cars seat belts are also provided for rear seat occupants also.



Fig : Seat Belt

Air Bags

An airbag is a vehicle safety device. This is one of the passive safety systems for the occupants of car. The electrical system of air bags includes the **impact sensors** and the electronic control module.

When there is an accident the sensor detects the impact and the air bag operates to save the driver and other occupants.



Fig : Air Bags

Energy-Absorber Safety Bumpers

Modern bumpers are designed to absorb the energy of a low-speed impact, minimizing the shock directed to the frame and to the occupants of the vehicle. Most energy absorbers are mounted between the bumper face bar or bumper reinforcement bar and the frame.

Security and Antitheft Devices

There are three basic types of antitheft devices available: locking devices, disabling devices, and alarm systems.

Exercise: Assignment

1. List the different Active & Passive safety device:

S.No.	List of Devices
1	
2	
3	
4	
5	

2. Fill in the blanks:

- Air bags are used for _____.
- Seat belt _____ in a vehicle.
- Passive safety helps in _____.
- Active system is used for _____ vehicle.
- Important accessories used in vehicle having are _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Role of Active & Passive safety

Part B

Discuss in class the following:

- ❖ Comfort used by active and passive safety
- ❖ Components of active and passive safety
- ❖ Advantages of active and passive safety.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to explain about active and passive safety		
Able to identify the components of active and passive safety		

Suggested Reading

Books

Title	Author	Publisher
Automobile Engineering Vol I	Kirpal Singh	Standard Publishers

Automobile Engineering, Vol II	Kirpal Singh	Standard Publishers
Text Book of Automobile Engineering	R. K. Rajput	Laxmi Publications
Automobile Engineering	R. K. Singal	S. K. Kataria and Sons
Automobile Engineering Theory	Kapil Dev	Computech Publications
Automobile Engineering	K. M. Moeed	S. K. Kataria and Sons

Websites

- ❖ auto.indiamart.com/auto-technology
- ❖ www.automobileindia.com/consumer-guide/automobile-technology
- ❖ auto.indiamart.com/auto-technology
- ❖ books.google.com/books/about/Automobile_Engineering.html
- ❖ www.bikeadvice.org
- ❖ www.wikipedia.com
- ❖ auto.indiamart.com/auto-technology
- ❖ <http://en.wikipedia.org/wiki/Airbag>

List of Contributors

1. Mr. Sunil K. Chaturvedi, CEO, Automotive Skills Development Council, Core 4-B 5th Floor India Habitat Centre, Lodhi Road, New Delhi – 110 003.
2. Mr. A.C. Deb, Sr. Lecturer, (Auto) – HOD, PUSA Polytechnic PUSA, New Delhi -110012.
3. Mr. Vikas Gautam, S.B.V. NO.1, Morigate, Delhi – 110006.
4. Prof. A.P. Verma, Ex-Prof. & HOD, PSSCIVE, Bhopal.
5. Sh. Deepak Shudhalwar, Assistant Professor, E & T Division, PSSCIVE, Bhopal.
6. Dr. Saurabh Prakash, Associate Professor, E & T Division, PSSCIVE, Bhopal – Programme Coordinato.

Unit-4

Road Safety

Introduction

All of you must have seen some road accident in which people lose their life. India has a very high number of accidents on the road. In recent years there is some improvement in this area. However, with rapid increase of vehicles on the road the traffic conditions are under a lot of pressure.

Therefore, road safety is one of the nation's most serious public health issues. It has an impact on everyone, whether you drive, walk or cycle. We should take care of ourselves and respect others on the road.



Fig : Road Accident

What is Road Safety

Road safety refers to methods be adopted by everyone while using roads. These safety methods are meant for reducing the risk of accidents and injuries or casualties on the road. These rules must be followed by all users of roads including pedestrians, cyclists, and motorists, bus & truck drivers. Safety methods also relate to the construction, layout of roads as well as traffic regulation systems. So we can summarise that road safety involves various aspects including:

- The design of roads and highways
- Laws pertaining to traffic and vehicles
- Systems of traffic safety and control
- Driver education
- School student's education about road safety
- Mass education about road safety
- Traffic and road safety signs
- Vehicle design
- Motor vehicle safety inspection and maintenance.

Actually it is not difficult to keep our roads safe. Imagine that everyone follows simple safety measures and traffic rules. In that situation there will not be any accidents.

In this Unit, you will develop an understanding of the various types of road safety measures to be adopted. You may understand Importance of safety rules, road signs, traffic signals and rules, driving rules, registration and licensing adopted in our country.

SESSION-1: IMPORTANCE OF ROAD SAFETY

Relevant Knowledge

Road Safety

Many studies have shown following major causes of road accidents are as follows:

- ❖ Highway safety.
- ❖ Driving in drunk condition.
- ❖ Driving in sleepy condition.
- ❖ Using cell phone while driving.
- ❖ Over speeding / rash driving.
- ❖ Driving in wrong lanes.
- ❖ Turning without giving signal.
- ❖ Overtaking from wrong side.

It can be seen that Road Safety is a collective responsibility. Therefore each one of us has to take steps required of us:

Government and Public Sector

To develop stricter road safety policies.

Generate/ Create funds for road safety awareness.

Stricter enforcement by government.

Building of better roads and highways.

Role of General Community

Acceptance of Road Safety Rules, Regulations and Policies.

Participation in Road Safety Awareness Drives to enhance their knowledge on Road Safety.

Education Sector

Inclusion of Road Safety modules in school curriculum.

Impart Road Safety education with the help of experts in this area.

Impart effective Driver Training for learners as well as existing drivers.

Role of Media

Communicate road safety messages through print and electronic media Support Road Safety initiatives through responsible and objective reporting.

Role of Health Professionals

Strengthen Trauma facilities in our country.

Organize workshops for saving the lives of people in road accidents.

Improvement in Infrastructure

Adopt effective and safe traffic management measures while planning designing of infrastructure.

For e.g. Proper road design, design of overbridges, road signages etc.

Hurdles in Road Safety

Negligence of Civilians.

Pathetic Condition of roads.

Unsafe Vehicle Design.

Under implementation of Road Safety Standards.

Lack of Emergency Services.

Important Schemes administered by Road Safety cell are:

- ❖ Publicity Programs.
- ❖ Grants-in-aid to Voluntary Organizations for organizing road safety programs.
- ❖ National Highway Accident Relief Service Scheme.
- ❖ Refresher Training to Heavy Vehicle Drivers in Unorganized Sector.
- ❖ Setting up of Model Driving Training school.
- ❖ Within the M.O.R.T.H.s massive road sector development program, the govt. is working closely with agencies: World Bank, Asian Development Bank to improve road safety.

Road Safety Tips

Road safety is a result of contributing efforts from all the sectors of the society including both civilians and Govt. officials. In addition to the human sufferings, the estimated costs of the road injuries are a noticeable amount in GNP per annum. So, some tips can be fruitful in this direction.

Few important Road Safety Tips are mentioned below:

- ❖ Don't use your mobile phone whilst driving.
- ❖ Use belt in the back seat also.
- ❖ Don't drink and drive.
- ❖ Always adhere to speed limits.
- ❖ Take special care about children, senior citizens and pedestrians.
- ❖ Don't drive if tired.
- ❖ Pedestrians should walk cautiously and always cross the road through Zebra crossing.
- ❖ Always observe and anticipate actions by other road users.
- ❖ Keep your distances and always wear helmets and seat belts.

Safety Devices



Fig : Bicycle Helmet



Fig : Air Bags



Fig : Two wheeler helmet



Fig : Two wheeler helmet

Two Wheeler Helmet: A two wheeler helmet is a type of protective headgear used by motorcycle and scooter riders. The primary goal of a two wheeler helmet is riders safety - to protect the rider's head during impact, thus preventing or reducing head injury or saving the rider's life. Some helmets provide additional conveniences, such as ventilation, face shields, ear protection etc.

Out of all the organs in our body, the heart and the brain are the most vital ones. When a two wheeler is involved in an accident, it is the brain that might be at a greater risk of injury. And only the brain is the one that might be affected the most. A brain injury can result due to skull fracture, a concussion, brain hemorrhage, which can result in death.

Even if a part of the brain has been damaged, it might result in the loss of speech or motor skills. In order to protect the brain one must wear a helmet. A motorcycle helmet protects the skull and the brain from extensive damage.

Exercise: Assignment

1. List the Road safety rules followed in road:

S.No.	Name of Rule
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Observe and identify road safety poster in your school and draw their diagrams:

3. Fill in the blanks:

- a) Accident take places in our daily life due to lack of _____ measure.
- b) Road safety is emerging as a major _____ in the country.
- c) Road safety is a _____ of contributing efforts from all the sectors of the society including both _____ and _____.
- d) Hurdles in road safety are _____ and _____.
- e) Important rules of road safety cannot be _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Share hurdles of road safety in our country.

Part B

Discuss in class the following:

- ❖ What is importance of road safety?
- ❖ What are the road safety tips?
- ❖ Why we should take care in road safety?
- ❖ Road safety importance can not be ignored.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to list hurdle of road safety		
Able to list road safety tips		

SESSION-2: SAFE AND RESPONSIBLE DRIVING

Relevant Knowledge

Safe and Responsible Driving Getting ready to drive Before driving

- ❖ Ensure that you are comfortable with your mental and physical condition.
- ❖ Inspect your vehicle and observe the driving conditions.

While driving you should carry your driving licence, registration certificate, insurance certificate and pollution control certificate. Transport and commercial vehicle drivers should carry the permits and vehicle fitness certificates also. A combination of knowledge, skill and attitude is required to be a safe driver.

Knowledge of traffic rules and driving practices that help traffic move safely. Skill to care about the safety of others on the road. We all are responsible for avoiding accidents.

Attitude to co-operate with other drivers to keep traffic moving safely. We must be courteous, giving other drivers space to change lanes, not cutting them off and signaling before turning.

Physical and mental alertness

Be in good physical and mental condition before driving.

DON'T DRIVE IF YOU

- ❖ have been drinking alcohol.
- ❖ taking any medicine or drug that affects your responses.
- ❖ are tired as tiredness affects your driving skills and reaction time.
- ❖ are sick or injured.
- ❖ are angry or upset.

You could be risking your life or lives of others on the road.

Know your vehicle

Go through the vehicle owner's manual.

You should know the features of the vehicle you are going to drive. Example - Anti-lock brakes, 4-wheel drive.

Ensure you know where the controls and instruments are and what they do. Check that all emergency signals and instruments work.

You should be able to turn on wipers, washers, headlights, indicators etc. without having to look at them and without taking your eyes off the road. Seating position Proper, upright position gives more stability while driving. Make sure you can see over the steering wheel and hood. You should be able to see the ground 4-5 feet in front of the vehicle for proper judgment.

Sit straight upright in the seat with your elbows slightly bent. Adjust the seat so your feet reach the pedals easily. Place your feet flat on the floor under the brake pedal. You are seated properly if you can do this. Adjust the head-rest to proper height. It protects in case of a collision.

Cars with air bags: Air bag can cause injuries if the seating position is incorrect.

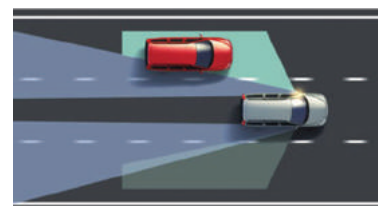
Know your blind spots

Blind spot is an area on each side of the vehicle that you cannot see through the mirrors. Mostly blind spots are to the back left and back right of the vehicle. In the above graphic, the red car is in the blind spot area of the silver car.

The green areas in the above graphic show the blind spots of the silver car. Adjust the mirrors to get the maximum view and identify your blind spots. You may not see vehicles when they are in these spots.



Fig : Seat Belt



Position the interior mirror so that the centre of the mirror shows the centre of the rear window. When the interior mirror is properly adjusted you would be able to see directly behind your vehicle.

The exterior (wing) mirror adjustment should be made while seated normally for driving. Do not set the right-hand exterior mirror by placing your head against the glass of the driver's door window. Do not adjust the left-hand exterior mirror by leaning to the centre of the vehicle.

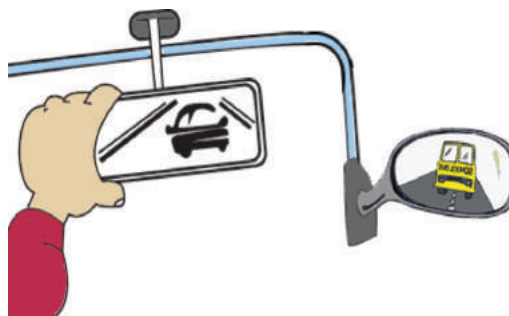


Fig : Adjustment of Interior Mirror

Side mirrors show only narrow angles of view, so you have to turn your head to make sure there is nothing in your blind spots.

Fasten your seat belt

Fasten your seat belt before you start. Seat belts are for your safety not just for avoiding challans.

Seat belts should be worn comfortable enough to keep you in your seat if there is a collision. Put the shoulder strap over your shoulder, never under your arm. The lap belt should be put low over the hips, not over the stomach.



Fig : Fasten your seat belt

Seat belt saves life

- ❖ Seat belt keeps you behind the wheel and in control of the vehicle in case of a collision.
- ❖ Seat belt keeps your head and body from hitting the inside of the vehicle.
- ❖ Seat belt keeps you inside the vehicle in a collision. A person who is thrown out of the vehicle during the collision has a higher chance of getting serious injury.

Turn on headlights at night and in poor light conditions

Turn on headlights around 30 minutes before sunset and keep them on until 30 minutes after sunrise. Turn on your lights when fog or rain reduces your visibility to less than 100 meters.

Keep your headlights clean and get them adjusted regularly so that they aim properly. In dim light, use your headlights, not parking lights. Parking lights are only for parking.



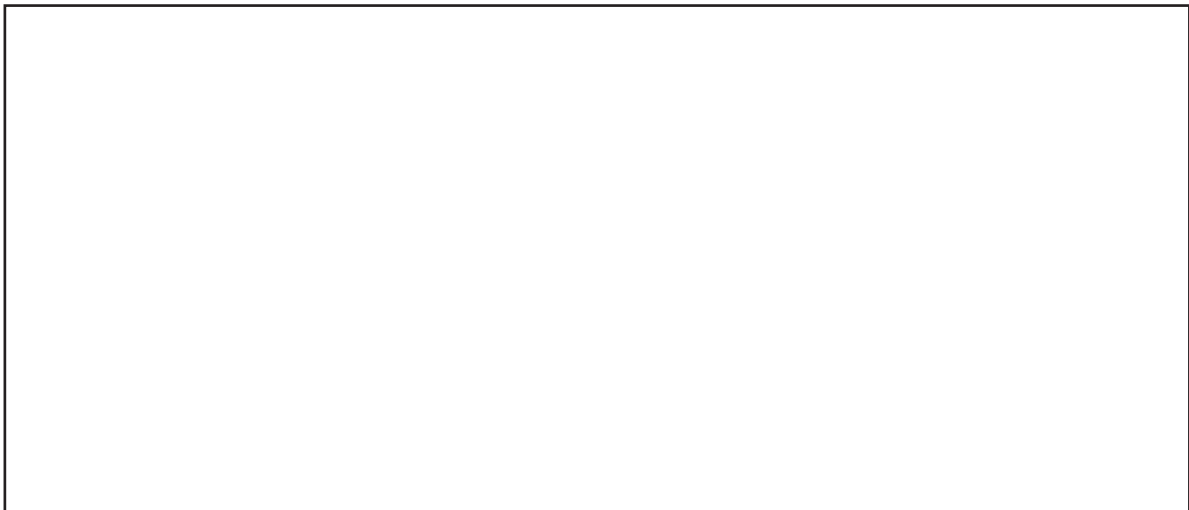
beams within 150 metres of an oncoming vehicle. Switch to your low beams when you are less than 60 meters behind another vehicle.

Exercise: Assignment

1. List the know your vehicle rule followed in driving:

S.No.	Name of Rule
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Draw the blind spot diagrams:



3. Fill in the blanks:

- a) Safety belt is used in _____.
- b) Before driving you should have important _____ with you.
- c) Mental status before driving should be _____.
- d) Mirror is adjusted to see _____ view.
- e) Avoid _____ and _____ while driving.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Safety precautions have been taken while driving two or four wheeler.

Part B

Discuss in class the following:

- ❖ Safe practices followed in car
- ❖ Different signs for different purpose.
- ❖ Blind spot while driving car.
- ❖ Use of high beam in vehicle.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to state safety procedure while driving		
Able to distinguish between various safety measures		

SESSION-3: ROAD SIGNS

Relevant Knowledge

Arm Signals

Signal plays important role during smooth movement of traffic. Road signals are to be followed systematically, otherwise it may lead to an accident. For use when direction indicator signals are not used, or when necessary to reinforce direction indicator signals and stop lights.



I intend to move in to the left or turn left



I intend to move out to the right or turn right



I intend to stop.



I intend to slow down.



Indicating the car following you to overtake.

TRAFFIC SIGNS

Traffic signs are divided into 3 main categories

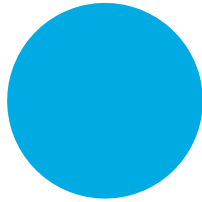
Mandatory/Regulatory signs

Cautionary signs

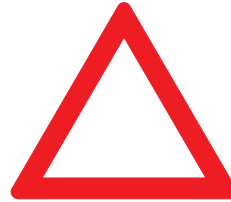
Information signs



Red circle instructs what should not be done.



Blue circle instructs what should be done.



Triangle cautions



Blue rectangle informs

TYPICAL CAUTIONARY SIGN



Right/Left Hand Curve: This sign is used where the direction of the road changes. The sign forewarns the driver to reduce the speed and proceed cautiously along the road.



Right/Left Hair Pin Bend: This sign is used where the change in direction is so considerable that it amounts to reversal of direction. The symbol bends to right or left depending upon the road alignment.



Right/Left Reverse Bend: This sign is used where the nature of the reverse bend is not obvious to approaching traffic and constitutes a hazard. If the first curve is to the right, a right reverse bend shall be used. If the first curve is to the left, a left reverse bend is used.



Narrow Bridge: This sign is erected on roads in advance of bridges where the clear width between the kerbs or wheel guards is less than normal width of carriageway.



Gap In Median: This sign is installed ahead of a gap in the median of a divided carriageway, other than an intersection.



Narrow Road: This sign is normally found in rural areas where a sudden reduction in width of pavement causes a danger to traffic.



Road Widens: This sign is normally found in rural areas where a sudden widening of road causes a danger to traffic, such as, a two-lane road suddenly widening to a dual carriageway.



Cycle Crossing: This sign is erected in advance of all uncontrolled cycle crossings.



Pedestrian Crossing: This sign is erected in advance of both approaches to uncontrolled pedestrian crossings.



School: This sign is erected where school buildings or grounds are adjacent to the road where the traffic creates a hazard to children.



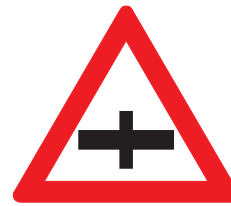
Men at Work: This sign is displayed only when men and machines are working on the road or adjacent to it or on overhead lines or poles. This sign is removed when the work is completed.



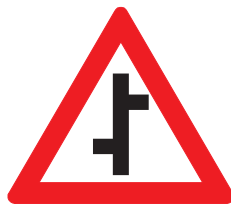
Side Road Left/Right: This sign is displayed in advance of the side road intersections where a large volume of entering traffic together with restricted sight distance is likely to constitute a hazard. The driver is warned of the existence of a junction.



Y-Intersection: These signs are displayed on the approach to a bifurcation of any road. This sign warns of the existence of a junction and no other indication given.



Major Road: These signs are displayed in advance of crossing with the major road, where a sufficiently large volume of traffic together with a sufficiently large volume of traffic together with restricted sight is likely to cause a hazard.



Staggered Intersection: This sign is used to indicate junctions where the distance between two junctions is not more than 60 meters.



T-Intersection: This sign is displayed in advance of T-junctions where the nature of inter-section is not obvious to approaching traffic. This sign is used to warn the driver of the existence of a junction.



Start of Dual Carriageway: This sign is displayed when a single carriageway ends into a dual carriageway.



Roundabout: This sign is used where it is necessary to indicate the approach to a roundabout.



End of Dual Carriageway: This sign is displayed when a dual carriageway is ending and a single carriageway is starting.



Reduced Carriageway: These signs caution the driver of the reduction in the width of the carriageway ahead. This is displayed on undivided carriageways when some portion of the carriageway is closed or reduced for repairs.

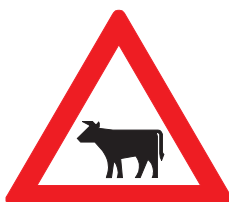


Two Way Operation: This sign is used to caution the driver of a changed pattern of traffic operation of the carriageway expected to carry traffic in one direction only.



Cross Road: This sign is displayed in advance of the cross road where a sufficiently large volume of crossing or entering traffic with restricted sight distance is likely to constitute a hazard.

TYPICAL CAUTIONARY SIGN



Cattle: This sign is used where there is danger due to farm animals or cattle crossing on the road.

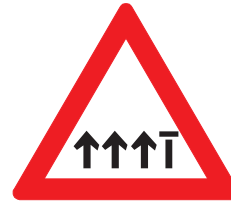


Traffic Diversion on Dual Carriageway:

This sign warns the driver of the diversion of traffic from one carriageway to the other. It is used on dual carriageway when one carriageway is closed.



Falling Rocks: This sign is used wherever rocks are liable to fall on the road seasonally or throughout the year. The symbol may be reversed to show the side from which rockfall is expected.



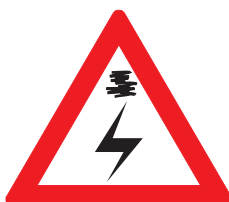
Ferry: This sign is used to warn the drivers about the existence of a ferry crossing across a river.

Lane Closure: This sign cautions the driver of the closure of a portion of the carriageway on multi-lane highways.



Barrier: This sign is erected in advance of a gate controlling entry into a road. A definition plate with words "SLOW BARRIER AHEAD" or "TOLL BARRIER AHEAD" is also displayed on the sign.

Loose Gravel: This sign is used on section of a road on which gravel may be thrown up by fast moving vehicles.



Overhead Cable: This sign cautions driver of the presence of overhead power transmission lines.



Rough Road: This sign is posted where the road is rough and the drivers are required to slow down their vehicles for safe travel.



Series of Bends: This sign is used to installed to caution the driver of the presence of zig-zag for a long distance over the section of road ahead.



Sudden Side Wind: This sign is used to caution the driver of the danger of side winds which endangers the lives of travellers. This sign is posted at places where such weather conditions exist.



Quarry Side or River Bank: This sign is used to caution the driver of the presence of water by the side of the road and the impending danger.



Runway: This sign is used to warn the drivers of the presence of runway ahead and possible movement of the aircrafts.



Slippery Road: This sign is used to warn that the section of the road ahead may be particularly slippery.



Traffic Signals: This sign is used to caution the drivers of the presence of traffic signals.



Unguarded Railway Crossing: This sign is used on the approaches of level crossings where there are no gates or other barriers. An advance warning sign (with two bars) is installed at a distance of 200 meters and second sign (with one bar) is installed near the crossing.



Guarded Railway Crossing: This sign is used to warn traffic on the approaches to guarded railway crossing. An advance warning sign (with two bars) is installed at a distance of 200 meters and second sign (with one bar) is installed near the crossing.



Steep Ascent/Steep Descent: This sign is displayed before a steep upgrade/downgrade that may constitute a hazard to traffic. A gradient of 10 per cent and above is considered steep gradient.



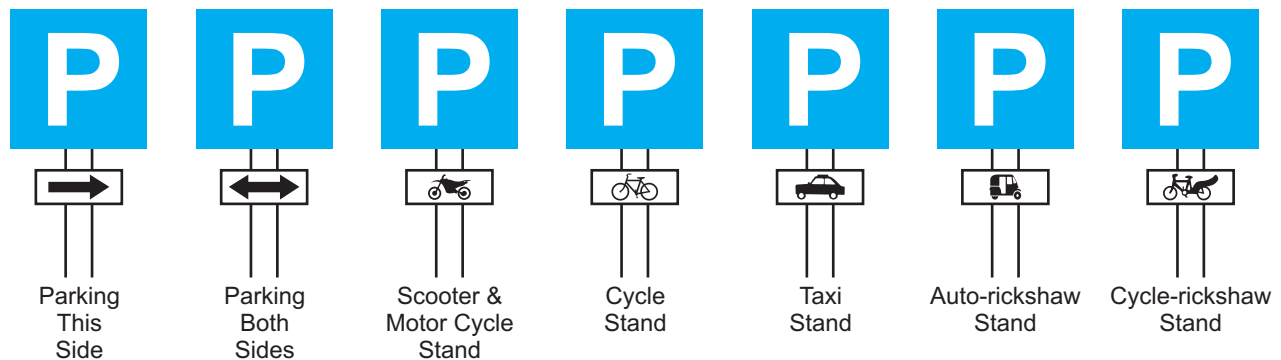
Sudden Side Wind: This sign is used to caution the driver of the danger of side winds which endangers the lives of travellers. This sign is posted at places where such weather conditions exist.

Traffic Signals: This sign is used to caution the drivers of the presence of traffic signals.



Speed Breaker: This sign warns the drivers of the presence of a speed breaker.

PARKING SIGNS



SPEED LIMIT AND VEHICLE CONTROL SIGNS

Speed Limit: This sign is erected at the beginning of the section of the road or area covered by a speed restriction, with numerals indicating the speed limit in kilometers per hour.



Width Limit: This sign is used where entry of vehicles exceeding a particular width is prohibited.



Height Limit: This sign is erected in advance of an overhead structure where entry is prohibited for vehicles whose height exceeds a certain limit.



Length Limit: This sign is used where entry of vehicles exceeding a particular length is prohibited.



Load Limit: This sign is used where entry of vehicles is prohibited for vehic.



Axle Load Limit: This sign is used where entry of vehicles is prohibited for vehicles whose gross load exceeds a certain limits.

PROHIBITORY SIGNS



Straight Prohibited or No Entry: These signs are located at places where the vehicles are not allowed to enter. It is generally erected at the end of one-way-road to prohibit traffic entering the roadway in the wrong direction and also at each intersection along the one-way road.



One Way Sign: These signs are located at the entry to the one-way street and repeated at intermediate intersections on that street.



Vehicles Prohibited in Both Directions: This sign is used at the approach end of the roads where entry to all types of vehicular traffic is prohibited, especially in areas which have been designed as pedestrian malls.

Horn Prohibited: This sign is used on stretches of the road where sounding of horn is not allowed, near hospitals and in silence zones.



Cycle Prohibited: This sign is erected on each entry to the road where cycles are to be prohibited.

Pedestrian Prohibited: This sign is erected on each entry to the road where pedestrians are to be prohibited.



Right/left Turn Prohibited: These signs are used at places where vehicles are not allowed to make a turn to the right or left. The signs are also used at the inter-sections of one-way street to supplement the one-way sign.



U-Turn Prohibited: This sign is used at places where vehicles are forbidden to make a turn to the reverse direction of travel between the sign and the next inter-section beyond it.

Overtaking Prohibited: This sign is erected at the beginning of such sections of highways where sight distance is restricted and overtaking will be dangerous.



All Motor Vehicles Prohibited: This sign is used at places where entry to all types of motor vehicles is prohibited.

Trucks Prohibited: This sign is used at the entrance to the road where movement of trucks is prohibited.



Hand Cart Prohibited: This sign is erected on each entry to the road where hand carts are to be prohibited.

Bullock Cart Prohibited: This sign is erected on each entry to the road where bullock carts are to be prohibited.



Tonga Prohibited: This sign is erected on each entry to the road where tongas are to be prohibited.

Bullock Carts & Hand Carts Prohibited: This sign is erected on each entry to the road where all types of slow moving vehicles except cycles are to be prohibited.

STOP AND GIVE WAY SIGNS



Stop Sign: This sign is used on roadways where traffic is required to stop before entering a major road. The vehicle shall proceed past the stop line only after ascertaining that this will not cause any damage to traffic on the main road.



Give Way Sign: This sign is used to assign right-of-way to traffic on certain roadways and intersections, the intention being that the vehicles controlled by the sign must give way to the other traffic having the right-of-way.

RESTRICTION ENDS SIGN



This sign indicates the point at which all prohibitions notified by prohibitory signs for moving of vehicles cease to apply.

COMPULSORY DIRECTION CONTROL AND OTHER SIGNS



Compulsory Turn Left/Right: These signs indicate the appropriate direction in which the vehicles are permitted to proceed.



Compulsory Ahead or Turn Left/Right: These signs indicate the appropriate directions in which the vehicles are permitted to proceed. Vehicles are supposed to move either of the given two directions.



Compulsory Ahead: This sign indicates that the vehicle is only permitted to proceed ahead.



Compulsory Keep Left: This sign is most frequently used on bollards or islands and refuges in the middle of the carriageway and at the beginning of central reserves of dual carriageway. The vehicles are obliged to keep left only.



Compulsory Cycle Rickshaw Track: This sign means only cycles and rickshaws are allowed on this road/carriageway.



Compulsory Sound Horn: This sign means the motor vehicles shall compulsorily sound horn at the location where the sign is placed. This sign is mostly put at sharp curves on hill roads.



Slip Road Ahead: This sign means the vehicles can either go straight or turn left.



Main Road Ahead: This sign means the vehicles can either go straight or turn right.



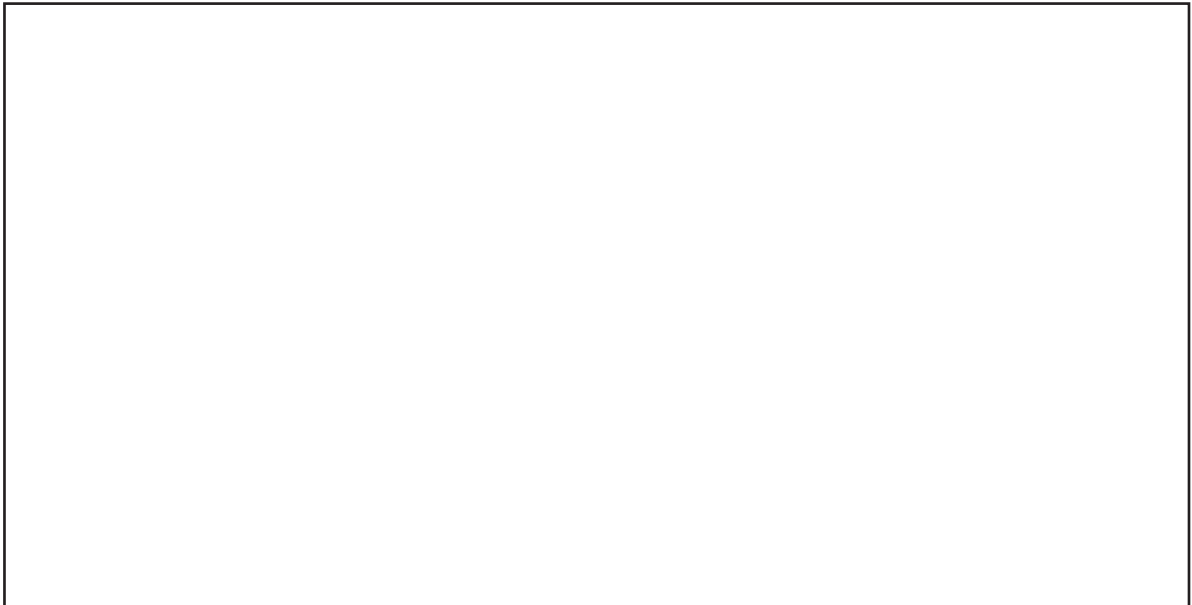
Pedestrians Only: This sign means only pedestrians are allowed and the traffic is not allowed on this road / carriageway.



Buses Only: This sign means that only buses are allowed and other traffic is not allowed on this road/carriageway.

Exercise: Assignment

1. Draw various signs of traffic:



2. Fill in the blanks:

- a) A traffic sign help in _____ movement of traffic.
- b) Hand can also be used as _____ in emergency.
- c) Signal traffic light have _____, _____ and _____ colour.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ All traffic signal are drawn and displayed.

Part B

Discuss in class the following:

- ❖ No entry sign.
- ❖ Different signs for different purpose.
- ❖ Signal role in road safety.
- ❖ Safety signs for different purpose help whom.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to draw road safety sign		
Able to distinguish between various safety road sign		

SESSION-4: DRIVING RULES AND REGISTRATION

Relevant Knowledge

The basic idea to devise driving rules is to make the traffic more organized and safe. Driving rules are very important; Government has made driving rules for the citizen. These rules are to be followed by every citizen. If you violate then you have to pay the fine or you have to appear in front of court. Rule and their rule number with penalty is explained here.

Driving rules

S.No.	Rules Description	Rule No.	Fine
1.	Violation of mandatory signs	199/177/MVA	Rs.100
2.	Improper Parking	122/177/MVA	Rs.100
3.	Without Helmet	129/177/MVA	Rs.100
4.	Not using seat belt	138.3/CMVR/177	Rs.100
5.	Dangerous Driving	184/MVA	Rs.1000
6.	Moving against one way	17RRR/177/MVA	Rs.100
7.	Using an registered vehicle/Violation of R. C. Condition	39/192/MVA	Rs.2000
8.	Number plate note as per guidelines	50/177/CMVR	Rs.100
9.	Without Light/Head/Tail light	105 CMVR/177/MVA	Rs.100
10.	Without Helmet pillion rider	129/177/MVA	Rs.100
11.	Tripple riding	128/177/MVA	Rs.100
12.	Carrying passenger in goods Vehicles	84.2/OMVR 177/MVA	Rs.100
13.	Conductor without uniform	23 DMVR 177 MVA	Rs.100
14.	Driver without uniform	7DMVR 177/MVA	Rs.100
15.	Driver without permit/Violation of permit conditions	66.1/192A/MVA	To court
16.	Without Registration Certificate	32/RRR/177/MVA	Rs.100
17.	Wrong overtaking	184/MVA	Rs.1000
18.	Violation of speed limit	112.1/183/MVA	Rs.400
19.	Use of Tinted Glass	100.2CMVR/177MVA	Rs.100
20.	Violation of stop line	177/MVA 185/MVA	Rs.100
21.	Drinking Driving	177/MVA	To court

22.	Violation of no entry restrictions	115/194/MVA	Rs.2000
23.	Other/Unspecified violations u/s		Rs.100

Registration

Whenever a vehicle is purchased then it is registered with State Transport office. All the district have Road Transport Office (RTO). RTO gives a registration number to all road vehicles. Every vehicle is fixed with a registration plate which is commonly known as number plates. These number plates are placed in the front and back of the vehicle.

Registration Rules and Process

Necessity for Registration

No person shall drive any Motor Vehicle and no owner of Motor Vehicle shall cause or permit the vehicle to be driven in any public place or any other place, unless the vehicle is registered in accordance with Chapter 4 of IMV Act 1988.

Registration where to be made?

Every owner of Motor Vehicle shall cause the Vehicle to be Registered by a Registration Authority in whose Jurisdiction he has residence or place of business where the vehicle is normally kept.

Temporary Registration

An application for Temporary Registration shall be made in Form 20 of the Central Motor Vehicle Rules, 1989 prescribed for Registration, under the Act marked "Temporary" to the Registering Authority or to the dealer dealing in the sale of New Motor Vehicles Recognised by the Transport Commissioner. It shall not be necessary to fill in the items 23 to 32 of the Form notwithstanding that be may be a Transport Vehicle.

Permanent Registration

An application for registration of a Motor Vehicle shall be made in **Form 20** to the Registering Authority within a period of 7 days from the date of delivery of such vehicle excluding the period of journey and shall be accompanied by Sales certificate in **Form 21**.

- ❖ Road worthiness certificate in **Form 22** from the manufacturers (**Form 22A** from the Body builder).
- ❖ Valid Insurance Certificate.
- ❖ Proof of Address (Ration Card, Electricity Bill, ...).
- ❖ Design approval copy of STA in case Trailer or Semi Trailer.
- ❖ Original Sales Certificate from the concerned Authorities in **Form 21** in the case of Ex_Army Vehicle.
- ❖ Pollution Under control Certificate.
- ❖ Customs Clearance Certificate in the case of Imported Vehicles.
- ❖ Appropriate Fee as specified in Rule 81 of CMV Rules

Exercise: Assignment

1. List the types of forms used in RTO office while registering a vehicle:

S.No.	Name of Forms
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Fill in the blanks:

- RTO is office used for _____ of vehicle.
- Vehicle registration is made at _____ office.
- Vehicle registration is compulsory for driving _____.
- Minimum age of driving of a vehicle is _____ year.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Differentiate between registration and license.

Part B

Discuss in class the following:

- ❖ Why registration is required?
- ❖ What are the different types documents used in registration?
- ❖ What are advantages of using driving license?
- ❖ Important rules of registration should be known to all.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to fill registration form		
Able to distinguish different registration form		

SESSION-5: DRIVING LICENSE

Relevant Knowledge

Driving License

As you must know that while driving a vehicle a person or driver must have a valid document of driving a vehicle. This document is called Driving License. We can say it driver's license/license or driving license, It is an official document which states that a person may operate a motorized vehicle, such as a motorcycle, car, truck or a bus, on a public roadway. Minimum age is 18 years for all vehicles, however motor cycle having engine capacity below 50 cc may be driven at age of 16.

According to the Motor Vehicle Act 1988, a valid Driving License is necessary to drive any motor vehicle on public roads.

- ❖ Driving License is issued by the Regional Transport Office (RTO) of Motor Vehicles Inspector's Office after the recipient has passed a driving test and has proved the required age.
- ❖ The Driving License in India is segregated as Motorcycle License, Light Motor Vehicle (LMV) license, and Heavy Motor Vehicle (HMV) License.
- ❖ Learner's License is issued after passing a theory test.
- ❖ The legislation of Driving License is done through the 'Rules of the Road Regulation' and the Motor Vehicle Act 1988.
- ❖ The driver of the vehicle is required to keep the original copy of the license while driving.

Types of Driving Licenses in India

To drive a motor vehicle in any public place an effective Driving License is necessary. By effective Driving License it means license issued to a person authorizing him/her to drive vehicle of that particular category. There are different types of licenses issued by the RTO offices. Here we will discuss each of them separately.

1. **Learner Driving License:** This is a temporary license that is valid up to 6 months from the date of issue. It is basically issued to learn driving of Motor Vehicles.
2. **Permanent Driving License:** Permanent driving license is issued to those who become eligible for it after thirty days (to apply within 180 days) from the date of issue of the learner license. Person suppose to get permanent driving license should be conversant about the vehicle systems, driving, traffic rules & regulations.
3. **Duplicate Driving License:** In case of loss, theft, or on mutilation, Duplicate License is issued. The documents to be produced are FIR of the lost license, challan clearance report from RTA Office (in case of Commercial licence renewal) and an application in Form LLD. The particulars are verified by the authority from the records. The duplicate license will have the valid period same as the previous license. If the license is lost and expired by more than 6 months it requires permission from Head Quarter of Transport Department.

It is recommended to keep a photocopy of the original license or particulars of license noted in order to make it easier for the issuing authority to locate the particulars from their record.

4. **International Driving License:** The motor licensing authority also issues International Driving License. The validity of this license is for one year. Person visiting the country is required to collect the license from there within one year period. Apart from address proof and birth certificate, one has to produce a valid passport and valid visa while applying.
5. **Motorcycle License or Two-wheeler License:** Two-wheeler license is issued by the Regional Transport Authority (RTO) to permit driving of only two-wheeler vehicles like bike, scooter and moped.
6. **Light Motor Vehicle License (LMV):** Light Motor Vehicle License is issued to drive light vehicles like auto rickshaws, motor car, jeep, taxi, three-wheeler delivery vans, etc.
7. **Heavy Motor Vehicle License (HMV):** Heavy Motor Vehicle License is issued to drive heavy vehicles like trucks, buses, tourist coaches, cranes, goods carriages, etc. A person with HMV license can drive light vehicles but Light Motor Vehicle License do not permit to drive heavy vehicles.

Exercise: Assignment

1. List the types of forms used in RTO office while making a licence:

S.No.	Name of Forms
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Fill in the blanks:

- a) RTO is office used for _____ of vehicle. 2. Driving licence is made at _____ office.
- b) License is compulsory for driving _____.
- c) Minimum age of driving licence of a vehicle is _____ year.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Differentiate between temporary and permanent license.

Part B

Discuss in class the following:

- ❖ Why license is required?
- ❖ What are the different types documents used in license?
- ❖ What are advantages of using driving license?
- ❖ Important rules of license should be known to all.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to fill license form		
Able to distinguish different license form		

Suggested Reading

Books

Title	Author	Publisher
Automobile Engineering Vol I	Kirpal Singh	Standard Publishers
Automobile Engineering, Vol II	Kirpal Singh	Standard Publishers
Text Book of Automobile Engineering	R. K. Rajput	Laxmi Publications
Automobile Engineering	R. K. Singal	S. K. Kataria and Sons
Automobile Engineering Theory	Kapil Dev	Computech Publications
Automobile Engineering	K. M. Moeed	S. K. Kataria and Sons

Websites

- ❖ auto.indiamart.com/auto-technology
- ❖ www.automobileindia.com/consumer-guide/automobile-technology
- ❖ auto.indiamart.com/auto-technology
- ❖ books.google.com/books/about/Automobile_Engineering.html
- ❖ www.bikeadvice.org
- ❖ www.wikipedia.com
- ❖ auto.indiamart.com/auto-technology
- ❖ <http://drivingtest.in/forms-fees-procedure.php>
- ❖ http://en.wikipedia.org/wiki/Driving_licence_in_India
- ❖ <http://india.gov.in/howdo/howdoi.php?service>
- ❖ www.chandigarhtrafficpolice.org

List of Contributors

1. Mr. Sunil K. Chaturvedi, CEO, Automotive Skills Development Council, Core 4-B 5th Floor India Habitat Centre, Lodhi Road, New Delhi – 110 003.
2. Mr. A.C. Deb, Sr. Lecturer, (Auto) – HOD, PUSA Polytechnic PUSA, New Delhi -110012.
3. Mr. Vikas Gautam, S.B.V. NO.1, Morigate, Delhi – 110006.
4. Prof. A.P. Verma, Ex-Prof. & HOD, PSSCIVE, Bhopal.
5. Sh. Deepak Shudhalwar, Assistant Professor, E & T Division, PSSCIVE, Bhopal.
6. Dr. Saurabh Prakash, Associate Professor, E & T Division, PSSCIVE, Bhopal – Programme Coordinator.

Unit-5

Automobiles and Our Environment

Introduction

Pollution is of great concern to the human race. As we know that we are not able to conserve our environment properly. If we don't start conserving our environment then our natural resources will be depleted / finished soon. Pollution in any form is dangerous. Pollution of air, water, noise has to be controlled to save our environment. It is necessary for us to adopt national and international emission standards which ensure better utilization of resources. These standards help in controlling the pollution. Governments all over the world are now serious about environment. Therefore, we get emission standards to follow in design & maintenance of automobiles. All the product and services have to follow national standards. Now day's strict measures are being taken by car designers to adopt Bharat Standard (BS). You must have noticed BSIV written on vehicles. This is the latest version of emission standards to be followed in India. Similarly all the vehicles are supposed to carry PUC certificate so that pollution is controlled. You should visit a nearby petrol pump and observe how they check pollution coming out of an automobile.

In this Unit, you will develop an understanding of the air pollution, auto emissions, Standards like EU/BS, PUC Certification and ways to control pollution.

SESSION-1: AIR POLLUTION

Relevant Knowledge

Air Pollution

Human population size has grown enormously over the last hundred years. This means increase in demand for food, water, home, electricity, roads, automobiles and numerous other commodities. These demands are exerting tremendous pressure on our natural resources, and are also contributing to pollution of air, water and soil. The need of the hour is to check the degradation and depletion of our precious natural resources and pollution without halting the process of development.

Pollution is an undesirable change in physical, chemical or biological characteristics of air, land, water or soil. Agents that bring about such an undesirable change are called **pollutants**. In order to control environmental pollution, the Government of India has passed the **Environment (Protection) Act, 1986** to protect and improve the quality of our environment (air, water and soil).

Air Pollution and Its Control

We are dependent on air for our respiratory needs. Air pollutants cause injury to all living organisms. They reduce growth and yield of crops and cause premature death of plants. Air pollutants also deleteriously affect the respiratory system of humans and of animals. Harmful effects depend on the concentration of pollutants, duration of exposure and the organism. Smokestacks of thermal power plants, smelters and other industries release particulate and gaseous air pollutants together with

harmless gases, such as nitrogen, oxygen, etc. These pollutants must be separated/ filtered out before releasing the harmless gases into the atmosphere.

Automobiles are also a major cause for atmospheric pollution at least in the metro cities. Actually it is the badly designed and badly maintained automobiles that are a major cause of air pollution. You must have seen on roads a bus or truck or car or tempo releasing black smoke. This is because of poor maintenance of the vehicle. This happens when engine is not



Fig : Photograph of Air Pollution

burning the fuel completely or properly. It can also happen because of improper mixture of air and fuel or perhaps the poor quality of fuel could be the reason. As the number of vehicles increase on the streets, this problem is now shifting to the other cities also. Proper maintenance of automobiles along with use of lead-free petrol or diesel can reduce the pollutants they emit. Catalytic converters, having expensive metals namely platinum-palladium and rhodium as the catalysts, are fitted into automobiles for reducing emission of poisonous gases. As the exhaust passes through the catalytic converter, unburnt hydrocarbons are converted into carbon dioxide and water. Also, carbon monoxide and nitric oxide are changed to carbon dioxide and nitrogen gas, respectively. Motor vehicles equipped with catalytic converter should use unleaded petrol because lead in the petrol reduces effectiveness of the catalyst.

Controlling Vehicular Air Pollution: A Case Study of Delhi

With its very large population of vehicular traffic, Delhi leads the country in its levels of air-pollution – it has more cars than the states of Gujarat and West Bengal put together. In the 1990s, Delhi ranked fourth among the 41 most polluted cities of the world. Air pollution problems in Delhi became so serious that a public interest litigation (PIL) was filed in the Supreme Court of India. After being censured very strongly by the Supreme Court, under its directives, the government was asked to take, within a specified time period, appropriate measures, including switching over the entire fleet of public transport, i.e., buses, from diesel to **compressed natural gas (CNG)**.

It was nice that the government of Delhi decided to convert all the buses of to run on CNG by the end of 2002. This resulted in dramatic improvement in the pollution levels.

You may ask the question as to why CNG is better than diesel. The answer is that CNG burns most efficiently and completely. On the other hand petrol or diesel are partly left un burnt. Moreover, CNG is cheaper than petrol or diesel, cannot be siphoned off by thieves and cannot be adulterated like petrol or diesel. The main problem with switching over to CNG is the difficulty of laying down pipelines to deliver CNG through distribution points/pumps and ensuring uninterrupted supply. Therefore you may have noticed long ques at the CNG stations.

Simultaneously parallel steps are also being taken for reducing vehicular pollution include phasing out of old vehicles, use of unleaded petrol, use of low-sulphur petrol and diesel, use of catalytic converters in vehicles, application of stringent pollution level norms for vehicles, etc.

The Government of India through a new auto fuel policy has made a plan to cut down vehicular pollution in Indian cities. More stringent norms for fuels means steadily reducing the sulphur and aromatics content in petrol and diesel fuels. Euro II norms, for example, stipulates that sulphur be controlled at 350 parts-per-million (ppm) in diesel and 150 ppm in petrol. Aromatic hydrocarbons are to be contained at 42 per cent of the concerned fuel. The goal, according to the roadmap, is to reduce sulphur to 50 ppm in petrol and diesel and bring down the level to 35 per cent. Corresponding to the fuel, vehicle engines will also need to be upgraded.

All automobiles and fuel-petrol and diesel – were to have met the Euro III emission specifications in these 11 cities from April 1, 2005 and have to meet the Euro-IV norms by April 1, 2010. The rest of the country will have Euro-III emission norm compliant automobiles and fuels by 2010. Thanks to the efforts made, the air quality has significantly improved in some cities like Delhi. According to an estimate, a substantial fall in CO₂ and SO₂ level has been found in Delhi between 1997 and 2005. This has been possible by introducing CNG buses on the roads.

Exercise: Assignment

1. List the reasons for Air Pollution:

S.No.	Reasons for Air Pollution
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Observe and identify Air Pollution poster in your school and draw their diagrams:



3. Fill in the blanks:

- a) Need of the hour is to check the _____ and _____ of our precious natural resources and pollution.
- b) In order to control environmental pollution, the Government of India has passed the _____ Act, 1986 to protect and improve the quality of our _____ (air, water and soil).
- c) Air pollutants deleteriously affect the _____ system of humans and of animals.
- d) Full form of CNG is _____.
- e) Automobiles are a major _____ for atmospheric pollution.
- f) Euro II norms, for example, stipulate that sulphur be controlled at _____ parts-per-million (ppm) in diesel and _____ ppm in petrol.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Share importance of air pollution.

Part B

Discuss in class the following:

- ❖ Why control of air pollution is necessary?
- ❖ What is the role of convertor in automobile?
- ❖ Case study of pollution control in Delhi.
- ❖ Importance of using CNG.
- ❖ Which first city has followed strictly air pollution norms?

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to explain reason of air pollution		
Able to explain measure to control air pollution		

SESSION-2: AUTO EMISSIONS AND EU/ BS STANDARDS

Relevant Knowledge

Sometimes you must have seen black or white smoke coming from car, scooter, tempo or truck. This smoke is a byproduct of combustion process and from evaporation of fuel itself. This smoke is called pollution. It is also known as auto emission.



Auto Emissions

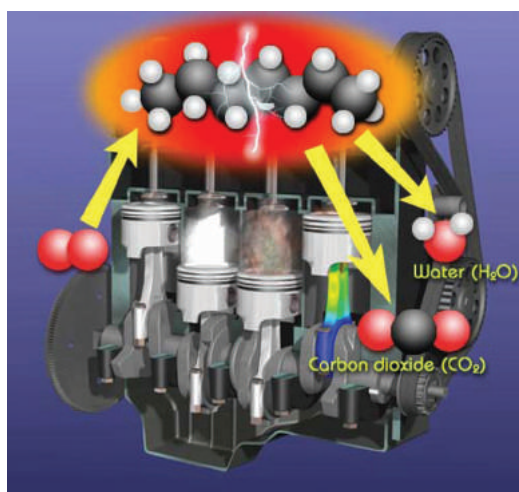
When emission from automobiles carry unburnt hydrocarbons it causes air pollution. Pollution from cars comes from by-products of this combustion process (exhaust) and from evaporation of the fuel itself.



Fig : Photograph of Automobile Emission

The Combustion Process

Petrol and diesel fuels are mixtures of hydrocarbons, compounds which contain hydrogen and carbon atoms. In a “perfect” engine, oxygen in the air would convert all the hydrogen in the fuel to water and all the carbon in the fuel to carbon dioxide. Nitrogen in the air would remain unaffected. In reality, the combustion process cannot be “perfect,” and automotive engines emit several types of pollutants.



Emission Standards

Governments and regulatory bodies all over the world sit down with Automobile companies and list down requirements that set specific limits to the amount of pollutants that can be released into the environment. Many emissions standards focus on regulating pollutants released by automobiles (motor cars) and other powered vehicles but they can also regulate emissions from industry, power plants, small equipment such as lawn mowers and diesel generators. Frequent policy alternatives to emissions standards are technology standards (which mandate Standards generally regulate the emissions of nitrogen oxides (NO_x), sulfur oxides, particulate matter (PM) or soot, carbon monoxide (CO), or volatile hydrocarbons (see carbon dioxide equivalent).

Emission Norms in India

With more and more vehicles coming on the roads there is possibility of large scale pollution caused by these vehicles. However, if vehicles are designed and maintained as per regulations then this danger will be reduced considerably.

It was only in 1991 that the first stage emission norms came into force for petrol vehicles and in 1992 for diesel vehicles. From April 1995 mandatory fitment of catalytic converters in new petrol passenger cars sold in the four metros of Delhi, Calcutta, Mumbai and Chennai along with supply of Unleaded Petrol (ULP) was affected. Availability of ULP was further extended to 42 major cities and now it is available throughout the country.

The emission reduction achieved from pre-1989 levels is over 85% for petrol driven and 61% for diesel vehicles from 1991 levels.

In the year 2000 passenger cars and commercial vehicles started meeting Euro I equivalent India 2000 norms, Euro II equivalent Bharat Stage II norms are in force from 2001 in 4 metros of Delhi, Mumbai, Chennai and Kolkata.

India is still behind Euro norms by few years. These are standards followed by European countries. However, with many vehicles manufactured in India now being exported a beginning has been made, and emission norms are being aligned with Euro standards and vehicular technology is being accordingly upgraded. Indian Vehicle manufactures are also working towards bridging the gap between Euro standards and Indian emission norms.

Bharat stage emission standards are emission standards instituted by Government of India to regulate the output of air pollutants from internal combustion engine equipments, including motor vehicles. The standards and the timeline for implementation are set by the Central Pollution Control Board under the Ministry of Environment & Forests.

Now a days India has adopted Bharat stage –IV norms in automobile sector. For metro cities it has become compulsory to use standard product.

The implementation schedule of EU emission standards in India is presented here in Table 1.

Table 1
Indian Emission Standards (4-Wheel Vehicles)

Standard	Reference	Date	Region
India 2000	Euro 1	2000 2001	Nationwide NCR*, Mumbai, Kolkata, Chennai
Bharat Stage II	Euro 2	2003.04 2005.06 2005.06	NCR*, 11 Cities† Nationwide NCR*, 11 Cities†
Bharat Stage III	Euro 3	2010.14	NCR*, 11 Cities† Nationwide
Bharat Stage IV	Euro 4	2010.14	NCR*, 11 Cities†

* National Capital Region (Delhi)

† Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Secunderabad, Ahmedabad, Pune, Surat, Kanpur and Agra

The above standards apply to all new 4-wheel vehicles sold and registered in the respective regions. In addition, the National Auto Fuel Policy introduces certain emission requirements for interstate buses with routes originating or terminating in Delhi or the other 10 cities.

For 2-and 3-wheelers, Bharat Stage II has been applicable since April 1, 2005 and Stage III standards came in force from April 1, 2010.

Exercise: Assignment

1. List the reasons for auto emission pollution:

S.No.	Reasons for Emission
1	
2	
3	
4	

2. Observe and identify auto emission of vehicle in your area and make sketches of your observations:



3. Fill in the blanks:

- Burning of fuel takes place in the _____ of automobile to give power to vehicle.
- Smokes are byproduct of _____ process (exhaust) and from _____ of fuel itself.
- First stage emission norms came into force for petrol vehicles in the year _____.
- Emission reduction achieved from pre-89 levels is _____ for petrol driven and _____ for diesel vehicles from 1991 levels.
- Euro II equivalent Bharat Stage II norms are in force from 2001 in 4 metros of _____, _____, _____ and _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Share role of emission in air pollution.

Part B

Discuss in class the following:

- ❖ Why emission control of air pollution is important?
- ❖ What is Bharat standards/Euro standard in automobile?
- ❖ How control of emission helps.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to explain importance of emission norms		
Able to discuss about bharat standards		

SESSION-3: PUC CERTIFICATION

Relevant Knowledge

In this chapter you have learnt about various aspects of automobile pollution and measures taken to control pollution.

Adulteration of fuel leads to the weak combustion process and ultimately leads to pollution. You must have read in newspaper that some petrol pump owner's adulterate petrol with kerosene to get higher margin of profit. They should not do this because it causes incomplete combustion which leads to air pollution from vehicles using adulterated petrol. Steps have also been taken to improve the quality of fuel. Proper maintenance of vehicle keeps pollution check by reducing the emission. Gradually, new measures like lead free fuel, CNG fuel, biofuel etc are also being adopted in automobile sector.

Hence quality of fuel is very important. The Fuel Quality plays a very important role in meeting the stringent emission regulation. The fuel specifications of petrol and diesel have been aligned with the Corresponding European Fuel Specifications for meeting the Euro II, Euro III and Euro IV emission norms.

As you have learnt that the use of alternative fuels has been promoted in India both for energy security and emission reduction. Delhi and Mumbai have more than 100,000 commercial vehicles running on CNG fuel. Delhi has the largest number of CNG commercial vehicles running anywhere in the World. India is planning to introduce Biodiesel, Ethanol Gasoline blends in a phased manner and has drawn up a road map for the same.

The Indian auto Industry is working with the authorities to facilitate introduction of alternative fuels. India has also setup a task force for preparing the Hydrogen road map. The use of LPG has also

been introduced as an auto fuel and the oil industry has drawn up plans for setting up of Auto LPG dispensing station in major cities.

Pollution Under Control (PUC) Certificate

Presently, all vehicles need to undergo a periodic emission check (3 months/6 months) at PUC Centers at Fuel Stations and Private Garages which are authorised to check the vehicles. It is mandatory for every vehicle owner to carry a valid Pollution Under Control (PUC) Certificate and maintain the vehicle with in prescribed emission norms.

You must have seen at a nearby petrol pump the Computerised facilities for checking of pollution levels and issue of PUC Certificates (to vehicles meeting emission standards). These authorised Pollution Checking Centres are spread in all cities. At present, number of Centres for petrol driven vehicles and the diesel driven vehicles are functioning. These centres issue Pollution Under Control Certificates (PUC) if the vehicle is found meeting prescribed emission norms. In case the vehicle is found polluting beyond prescribed norms, necessary repairs/ tuning in the vehicle would be required.

If a vehicle is not having the valid PUC pollution certificate, then is liable to be prosecuted under Section 190(2) of the Motor Vehicles Act. A penalty of Rs. 1000/- for first offence and Rs. 2000/- for every subsequent offence of violation has been provided.

Fees for pollution checking are fixed by state transport department and it is very nominal like:-

Petrol / CNG / LPG vehicle Rs.25

Diesel vehicle Rs.50

Minor adjustment (Carbureted petrol vehicles only) Rs.5

If any vehicle is found polluting although it is carrying a valid PUC certificate then The PUC Certificate of vehicle shall be cancelled and you will be directed (under Rule 116 of CMV Rules) to produce a fresh PUC Certificate within seven days. The failure to comply with this direction would result in prosecution under section 190(2) of the Motor Vehicles Act.. if vehicle is not polluting and PUC Certificate has expired or I do not have a PUC Certificate then also offence of not having a PUC Certificate also attracts prosecution under section 190(2) of the Motor Vehicles Act.

There are regulations also that require, transport vehicles to undergo an annual fitness check carried out by RTOs for emissions, safety and road worthiness. Now the government is also preparing plans for compulsory inspection of vehicles after a certain number of years.

Some other way to control pollution is to

Keep car one day off in a week

Pool the car for going to office

Use bicycle for short distances

Keep your vehicle properly maintained

Delhi metro is best example of controlling pollution and providing comfort to the public.



Exercise: Assignment

1. List the reasons for controlling pollution:

S.No.	Reasons for Air Pollution
1	
2	
3	
4	
5	
6	

2. Prepare a poster depicting controlling of air pollution by better Designed and better maintained automobiles:

--

3. Fill in the blanks:

- a) New alternate fuel used in Delhi is _____.
- b) Meaning of PUC is _____.
- c) PUC is checked at _____.
- d) Full form of CNG is _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for pollution control.

Part A

- ❖ Share importance of air pollution.

Part B

Discuss in class the following:

- ❖ Why control of pollution is necessary ?
- ❖ What is the purpose of PUC?
- ❖ Important tips about controlling pollution.
- ❖ Delhi metro is successful model of controlling pollution.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to explain importance of pollution control		
Able to discuss about role of PUC		

Suggested Reading

Books

Title	Author	Publisher
Automobile Engineering Vol I	Kirpal Singh	Standard Publishers
Automobile Engineering, Vol II	Kirpal Singh	Standard Publishers
Text Book of Automobile Engineering	R. K. Rajput	Laxmi Publications
Automobile Engineering	R. K. Singal	S. K. Kataria and Sons
Automobile Engineering Theory	Kapil Dev	Computech Publications
Automobile Engineering	K. M. Moeed	S. K. Kataria and Sons

Websites

- ❖ auto.indiamart.com/auto-technology
- ❖ www.automobileindia.com/consumer-guide/automobile-technology
- ❖ auto.indiamart.com/auto-technology
- ❖ books.google.com/books/about/Automobile_Engineering.html
- ❖ www.bikeadvice.org
- ❖ www.wikipedia.com

List of Contributors

1. Mr. Sunil K. Chaturvedi, CEO, Automotive Skills Development Council, Core 4-B 5th Floor India Habitat Centre, Lodhi Road, New Delhi – 110003.
2. Mr. A.C. Deb, Sr. Lecturer, (Auto) – HOD, PUSA Polytechnic PUSA, New Delhi -110012.
3. Mr. Vikas Gautam, S.B.V. NO.1, Morigate, Delhi – 110006.
4. Prof. A.P. Verma, Ex. HOD, PSSCIVE, Bhopal.
5. Sh. Deepak Shudhalwar, Assistant Professor, E & T Division, PSSCIVE, Bhopal.
6. Dr. Saurabh Prakash, Associate Professor, E & T Division, PSSCIVE, Bhopal – Programme Coordinator.

Unit-6

Introduction to Vehicle Maintenance and Servicing

Introduction

Automobiles need Maintenance from time to time. Like we need to wash, bathe similarly our automobiles also need to be kept clean. Automobiles have to run on dirty roads and in polluted environment. Automobiles also run on uneven roads with pot holes and other obstructions. Automobiles and its parts are subjected to loads as described above. This makes them either damaged or in poor working condition. Therefore there is need for regular maintenance and servicing of automobiles. Maintenance of an Automobile is usually done in a place called Auto Workshop or Auto Service Station.

In this Unit, you will develop an understanding of the concept of vehicle maintenance and servicing.

SESSION-1: IMPORTANCE TO VEHICLE MAINTENANCE AND SERVICING

Relevant Knowledge

As you know that there is increase in the number of vehicle in our city. Vehicles such as motorcycle, scooter, bus, car, jeep, tempo, truck and tanker etc are running in the our cities.

Every new vehicle comes with a vehicle maintenance manual. Vehicle owner should read and use this manual. This manual helps user for vehicle maintenance tips during driving. People after getting a car or vehicle often care little about regular car maintenance.

Although you may be doing regular servicing of your vehicle, but with the help of vehicle maintenance tips given in your vehicle maintenance manual, lasting of your vehicle can be increased to a much greater extent.

The Vehicle Maintenance and Servicing is carried out when the vehicle completes certain kilometer on its normal running and when the vehicle does not give proper performance. It is suggested that vehicle owner should do regular and periodical checkup of their vehicle. Some of checks are given her for users.

Daily Inspection (DI)

It is the responsibility of a driver or owner of a vehicle to carry out the following inspection/checks daily before the starting of engine to avoid any type of breakdown on the road.

- ❖ Check all the tyre pressure visually or hitting the tyre wall with the help of a stone piece and judging the sound.
- ❖ Check radiator coolant level.
- ❖ Check the fan belts for looseness.

- ❖ Check the level of engine oil.
- ❖ Check the wind screen, rear view mirror and rear window glass for their cleanliness.

Maintenance Checkup

When you plan to go outside from your home for long distance travel, It is necessary to do some routine checkup. We should read vehicle maintenance manual for more clarification. Some of important checkups is to be done for better maintenance.

1. Topping of oil level
2. Proper tension of Belt
3. Battery for cleanliness and level of electrolyte (Add only distilled water for topping of electrolyte water)
4. Brakes
5. Topping up of Coolant if required in the coolant reservoir
6. Check the Serviceability of cooling system Hoses
7. Proper Tyre inflation pressure
8. Air-conditioning.

Vehicle maintenance/checkup is generally done at vehicle service centre. You must visit to nearby vehicle service centre and see how a vehicle is being properly maintained.

We will be visiting a nearby vehicle service centre and see the how the common checkups are being made by service mechanic. Some of important checkup are discussed here:

Check/Top up all vehicles' oil levels: Service mechanic with the help of measuring stick check the engine oil, coolant, brake oil, and water. During routine checkup, oil, water, coolants are topped up otherwise it is changed.

Belt Checkup: Checking of belt is very important. If it is loose or broken then it will be replaced immediately.

Battery: Battery is very important component of a vehicle. It should be checked up regularly. Battery electrolyte (distilled water) is checked by removing the battery caps and looking inside. If level is low, it will be topped up by distilled water. Now day's battery are maintenance free batteries. Maintenance free batteries have sealed caps and require no checking. But some batteries say maintenance free but do have removable caps. These should be checked in the usual manner.

Brakes: Service mechanic checkup the break also by pushing the pedal. If he feels that there is need of servicing, he will inform to the customer.



Fig : Service Centre

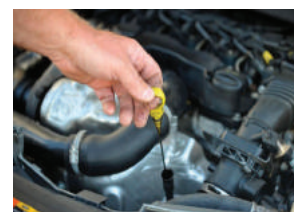


Fig : Checking of Oil Levels



Fig : Battery



Fig : Wheel Brakes

Cooling System: Technician checks the cooling system by topping up the coolant. The cooling system should be refilled with the correct coolant. Don't refill with just straight water.



Fig : Cooling System

Air-conditioning: Service mechanic will check the cooling and heating by checking the airflow is coming from all appropriate vents.



Fig : Air-conditioning

Tyres: Mechanic will check the tyre by checking correct tyre pressures. He will also see also external damage also if any.



Fig : Tyres

The Safety Rules during servicing of vehicle to be followed: You have visited the service station and seen that service technician is doing their work properly. During servicing of vehicle in a garage or service station the technician must follow some precaution and safety rules to prevent the accidents to occur, please observe that whether safety rules are being followed or not. These safety rules are:

- ❖ Always select right tools for specific job. The wrong tool could damage the part being worked on and could cause you to get hurt.
- ❖ Keep your tools and equipments under control.
- ❖ Wipe excess oil and grease off your hands and tools so that you can get a good grip on tools or parts.
- ❖ Work quietly and give full attention on your job.
- ❖ Keep jack handles out of the way. Stand the creeper against the wall when it is not in use.



Fig : Service Station

- ❖ Do not put sharp objects, such as screw drivers, in your pocket. You could cut yourself or get stabbed, you could damage the seat.
- ❖ Make sure that technician cloths are right for the job and he should wear full leather safety shoes.
- ❖ If oil, grease, or any liquid spill on the floor, clean it up so that no one will slip and fall.
- ❖ Always wear eye protection when using a grinding wheel or welding equipment or working with chemicals such as solvents.
- ❖ While using jack, place it properly to avoid slip.
- ❖ Never run an engine in a closed garage that does not have proper ventilation system. The exhaust gases contain carbon monoxide. Carbon monoxide is a colourless, odorless, tasteless poisonous gas that can kill you.

Exercise: Assignment

1. List the pre checkup activity of a vehicle to be taken:

S.No.	Pre Checkup Activity
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Observe and identify vehicles in your area/ premises and suggest preventative maintenance to be taken:

Type of Vehicle	Preventive Maintenance

3. Fill in the blanks:

- a) The Vehicle Maintenance and Servicing is carried out when the vehicle completes _____ kilometer.
- b) After overhauling the vehicle regains its almost _____.
- c) When you plan to go _____ from your home for long distance travel, take some time to make sure that your _____ is ready to take you to outside.

- d) During pre checkup following items like vital fluids, battery, _____, air conditioning, _____, belt & hoses, cooling system should be touched.
- e) Always select right _____ for specific job. The wrong tool could damage the part being worked on and could cause you to get _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Pre check points of an vehicle.

Part B

Discuss in class the following:

- ❖ What Safety Rules during servicing of vehicle to be followed?
- ❖ Why right tools are selected for right jobs. List the reasons?
- ❖ Important safety gadget should be used by service technician.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to list pre service checkup which should be done by vehicle owner		
Able to list safety precautions during vehicle checkup and servicing		

SESSION-2: TIPS TO EXTEND THE LIFE OF VEHICLE

Related Knowledge

Care and Maintenance tips keep your car running in good condition. These tips will help in better maintaining of a vehicle. You must observe these points in your daily life.

1. Drive the vehicle with care everyday
2. Be patient during the accident or breakdown of a vehicle, call helpline number of vehicle or police or hospital
3. Buy petrol at reputable service stations
4. Don't fill up if you see the tanker
5. Go easy when you're stuck
6. Car key chain should be lighten
7. Preserve your car during long-term storage
8. Park in the shade
9. Clean the inside, too
10. Clean dash gauges carefully

11. Preserve door and window seals
12. Don't try to carry too much
13. Use upholstery cleaners on soiled seats
14. Place a towel under baby seats
15. Protect car paint from the sun
16. Wash in winter
17. Wax to protect your car's paint job
18. Maintain proper inflation
19. Check for uneven wear
20. Rotate your tires
21. Have wheel alignment checked
22. Top off your brake fluid
23. Care for anti-lock brakes
24. Check engine oil at every other fill-up
25. Change oil frequently
26. Don't mix coolants
27. Avoid hose hassles
28. Test drive-belt tension
29. Clean your engine
30. Run your AC in winter
31. Maintain your car's battery
32. Seal a leaky radiator
33. Dilute your coolant.

Exercise: Assignment

1 List some important safety tips of a vehicle:

S.No.	Tips
1	
2	
3	
4	
5	
6	
7	
8	

2. **Observe and draw maintenance practices done of a vehicle in your area:**

3. **Fill in the blanks:**

- a) Clean dash gauges _____.
- b) Let floor mats _____ winter's beating.
- c) Maintain proper inflation in _____.
- d) Protect _____ paint from the sun .
- e) Preserve door and _____ seals.
- f) Fix bad _____ stripping immediately.
- g) Keep leather from _____ and cracking.
- h) Maintain your _____ car's battery.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- ❖ Importance of safety tips of a vehicle.

Part B

Discuss in class the following:

- ❖ What is the use of servicing a vehicle?
- ❖ Important service tips.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to list the tips of servicing of a vehicle		
Able to list the servicing point of a vehicle		

SESSION-3: INTRODUCTION TO VEHICLE SERVICE PROCEDURE

Related Knowledge

During the visit of vehicle service centre, you must have seen that authorized automobile service centre adopt certain procedure during service of a vehicle. We shall list the common activity done in the centre. One of the most important part is Job Card and its filling procedure. At this level you must know some of these servicing activities in your training programme.

Common activity in the workshop:

- ❖ Job card and its filling procedure
- ❖ Washing of vehicle and Washing Procedure
- ❖ Engine Minor tune up
- ❖ Oil Replacement
- ❖ Checking of battery electrolyte level and top up
- ❖ Clutch and brake free play and their adjustment
- ❖ Lighting System, its various part and their checking
- ❖ Identification of greasing points of wheelers and procedure of greasing
- ❖ Checking of tyre inflation and procedure of inflation.

Job card and its filling procedure

When a vehicle owner enters in service centre. He is attended by supervising engineer. Customer informs about vehicle defect After getting the feed back from the vehicle owner/driver regarding defects of the vehicle, the supervising engineer in a service station or workshop carry out an inspection on it. The defects pointed out or listed are noted down in a standard format, which is called the Job card or Work Order.

In order to indicate his satisfaction with the diagnosis made by the supervising engineer, the customer of the vehicle puts his signature on the Job card before the repairs on the vehicle are started. The work assigned to the appropriate person to carry out the repairs. And the supervisor puts his signature on the job card. The work order/Job card is prepared in duplicate.

Contents of a standard job card

- ❖ Job card Number
- ❖ Name address & phone no. of the Service Centre
- ❖ Name address & phone no. of customer
- ❖ Details of vehicle such as – Make; Model, Registration No., Chassis No, Engine No., Date of Sale, Kms. Reading, Receiving date & time and delivery date & time by the service centre
- ❖ Check list before trial
- ❖ Customer's observation
- ❖ Job to be done
- ❖ Estimated cost in Rs. for customer and Insurance company

- ❖ Labour required
- ❖ Name of Mechanic
- ❖ Name & Signature of Supervisor
- ❖ Customer's authorization for repair and his signature
- ❖ Acknowledgment.

Filling the Job Card: Almost all the information's must be properly filled in the job card by the supervisor and has to be signed by him and the customer also has to sign on the authorization for work column. Then the repairing or servicing job on the vehicle is taken over. A standard job card is shown below. The student must practice to fill the same.

	YAMAHA	JOB CARD NO. 14050																																																													
SETCO 09/2-A, Industrial Area, Nazafgarh Road, Near Hans Motors, Behind Moti Nagar Bus stand, New Delhi-110015 Tel. : 011-04044400, 925558445 Branch 1 : 847/2, Main Mata Chowk, Vasant Vihar Road, Mahipalpur, New Delhi-110037 Tel. : 01105464401, 925555445 Branch 2 : C-240, Near Radha Krishna Mandir, Pandav Nagar, Delhi-110002 Tel. : 011-22483501, 926857337 E-mail : services @sotoo.biz		Name : Address : Phone : Res.: Office : Mobile : Model : Regn. No. : Chassis No. : Engine No. : Date of Sale : Kms. Reading : Receiving Date & Time : Delivery Date & Time :																																																													
Free Service No. Coupon No.		Protection Plus ☐ Paid ☐ Warranty ☐ FOC ☐ Accidental ☐ Complaint ☐																																																													
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">CHECK LIST</th> <th style="width: 10%;">OK</th> <th style="width: 10%;">Not OK</th> </tr> </thead> <tbody> <tr> <td>Check Before Trial</td> <td></td> <td></td> </tr> <tr> <td>Engine : Idle RPM</td> <td> </td> <td> </td> </tr> <tr> <td>Engine Oil Qty.</td> <td> </td> <td> </td> </tr> <tr> <td>Electrical : Battery</td> <td> </td> <td> </td> </tr> <tr> <td>Horn</td> <td> </td> <td> </td> </tr> <tr> <td>Type Pressure :</td> <td></td> <td></td> </tr> <tr> <td>Front / Rear PSI</td> <td> </td> <td> </td> </tr> <tr> <td>Clutch Lever Free Play</td> <td> </td> <td> </td> </tr> <tr> <td>Brake Lever Free Play</td> <td> </td> <td> </td> </tr> <tr> <td>Brake Pedal Free Play</td> <td> </td> <td> </td> </tr> <tr> <td>Damage & Shortages-Yes</td> <td></td> <td>No</td> </tr> <tr> <td>Lights (HL/TL/BL/Win/Pilot)</td> <td></td> <td></td> </tr> <tr> <td>Rear View Mirror (L/R)</td> <td></td> <td></td> </tr> <tr> <td>Dent (D) / Scratched (s) :</td> <td></td> <td></td> </tr> <tr> <td>Choke Cap : Yes/No</td> <td></td> <td></td> </tr> <tr> <td>Tool Kit : Yes/No</td> <td></td> <td></td> </tr> <tr> <td>Accessories :</td> <td></td> <td></td> </tr> <tr> <td>Fuel Level</td> <td></td> <td></td> </tr> <tr> <td>Others (if any) :</td> <td></td> <td></td> </tr> </tbody> </table>	CHECK LIST	OK	Not OK	Check Before Trial			Engine : Idle RPM			Engine Oil Qty.			Electrical : Battery			Horn			Type Pressure :			Front / Rear PSI			Clutch Lever Free Play			Brake Lever Free Play			Brake Pedal Free Play			Damage & Shortages-Yes		No	Lights (HL/TL/BL/Win/Pilot)			Rear View Mirror (L/R)			Dent (D) / Scratched (s) :			Choke Cap : Yes/No			Tool Kit : Yes/No			Accessories :			Fuel Level			Others (if any) :			Customer's Observation	Job to be Done	Estimated Cost Rs.
CHECK LIST	OK	Not OK																																																													
Check Before Trial																																																															
Engine : Idle RPM																																																															
Engine Oil Qty.																																																															
Electrical : Battery																																																															
Horn																																																															
Type Pressure :																																																															
Front / Rear PSI																																																															
Clutch Lever Free Play																																																															
Brake Lever Free Play																																																															
Brake Pedal Free Play																																																															
Damage & Shortages-Yes		No																																																													
Lights (HL/TL/BL/Win/Pilot)																																																															
Rear View Mirror (L/R)																																																															
Dent (D) / Scratched (s) :																																																															
Choke Cap : Yes/No																																																															
Tool Kit : Yes/No																																																															
Accessories :																																																															
Fuel Level																																																															
Others (if any) :																																																															
Note : 1) Please advice Customer on "Not OK" points. 2) Please verify Customer Observation.		LABOUR																																																													
		TOTAL																																																													
Mechanic Name :		Supervisor's Sign :																																																													
CUSTOMER AUTHORIZATION																																																															
I hereby Authorise the above jobs to be done & parts, if required it will be at my cost. Any additional jobs or parts required shall be at my cost. Vehicle is stored, repaired, tested and driven at my risk. Estimate given above for the labour charges and parts is only approximate.																																																															
Customer Signature		Date:																																																													
Job Card No. SETCO 09/2-A, Industrial Area, Behind Moti Nagar Bus stand Tel. : 011-04044400, 925558445 Branch 1 : 847/2, Mahipalpur Tel. : 01105464401, 925555445 Branch 2 : C-240, Pandav Nagar Tel. : 011-22483501, 926857337 E-mail : services @sotoo.biz		Acknowledgment Date: Regn. No. : Chassis No. Receiving Date Delivery Date/Time Model : Supervisor's Signature																																																													

Exercise: Assignment

1. List some important vehicle service procedure of a vehicle:

S.No.	Vehicle Service Procedure
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2. Fill in the blanks:

- Job card is used for filling _____ of a vehicle.
- Customer of the vehicle puts his _____ on the Job card before the repairs on the vehicle are started.
- The work order/Job card is prepared in _____.
- Engine tune up means different things to different _____.
- The work order/Job card is prepared in _____.

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for Assessment Activity.

Part A

- Importance of safety service procedure of a vehicle.

Part B

Discuss in class the following:

- What is the use of servicing a vehicle?
- Job card and its importance.
- Activities during service of a vehicle.

Performance standards/criteria covered by this assessment

Performance Standards	Yes	No
Able to discuss safety service procedure		

Suggested Reading

Books

Title	Author	Publisher
Automobile Engineering Vol I	Kirpal Singh	Standard Publishers
Automobile Engineering, Vol II	Kirpal Singh	Standard Publishers
Text Book of Automobile Engineering	R. K. Rajput	Laxmi Publications
Automobile Engineering	R. K. Singal	S. K. Kataria and Sons
Automobile Engineering Theory	Kapil Dev	Computech Publications
Automobile Engineering	K. M. Moeed	S. K. Kataria and Sons

Websites

- ❖ auto.indiamart.com/auto-technology
- ❖ www.automobileindia.com/consumer-guide/automobile-technology
- ❖ auto.indiamart.com/auto-technology
- ❖ books.google.com/books/about/Automobile_Engineering.html
- ❖ www.bikeadvice.org
- ❖ www.wikipedia.com

List of Contributors

1. Mr. Sunil K. Chaturvedi, CEO, Automotive Skills Development Council, Core 4-B 5th Floor India Habitat Centre, Lodhi Road, New Delhi – 110003.
2. Mr. A.C. Deb, Sr. Lecturer, (Auto) – HOD, PUSA Polytechnic PUSA, New Delhi -110012.
3. Mr. Vikas Gautam, S.B.V. NO.1, Morigate, Delhi – 110006.
4. Prof. A.P. Verma, Ex. HOD, PSSCIVE, Bhopal.
5. Sh. Deepak Shudhalwar, Assistant Professor, E & T Division, PSSCIVE, Bhopal.
6. Dr. Saurabh Prakash, Associate Professor, E & T Division, PSSCIVE, Bhopal – Programme Coordinator.