Autoshop Repair and Practice

Student Handbook

Class XI

CENTRAL BOARD OF SECONDARY EDUCATION
Shiksha Kendra, 2, Community Centre, Preet Vihar, Delhi- 110301


BUILDING SKILLS•BUILDING FUTURE•

Autoshop Repair and Practice

STUDENT HANDBOOK

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Student Handbook, Class XI

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भारत का संविधान

उद्देशिका

हम, भारत के लोग, भारत को एक सम्पूर्ण [1]प्रभुत्व-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
[2]और राष्ट्र की एकता और अखंडता
सुनिश्चित करने वाली बंधुता बढ़ाने के लिए

दृढ़संकल्प होकर अपनी इस संविधान सभा में आज तारीख 26 नवम्बर, 1949 ई॰ को एतद्द्वारा 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 कर्त्तव्य

51 क. मूल कर्त्तव्य – भारत के प्रत्येक नागरिक का यह कर्त्तव्य 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 परीक्षण करे;

(छ) प्राकृतिक पर्यावरण की जिसके अंतर्गत वन, झील, नदी, और वन्य जीव हैं, रक्षा करे और उसका संवर्धन करे तथा प्राणिमात्र 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 है, 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 द्वारा प्रतिस्थापित।

THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a **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 the 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;

(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

People globally, are truly living in the era of wheels. Millions of people depend on their vehicles as their primary means of transportation. Therefore, experts predict a strong demand for skilled automobiles technicians and related professionals for the foreseeable future.

In an attempt to equip the students with this skill, CBSE has introduces Automobile Technology as vocational courses at Secondary and Senior Secondary level, this Student Handbook titled "Autoshop Repair and Practice" for class-XI was prepared. PSSCIVE Bhopal has supported in preparing the Handbook for the benefit of the students who opt for the course.

Ample care has been taken to align the subject with National Occupation Standards (NOS) which are competency based standards identified by the Automobile industry to train students in knowledge and skills that equip students to perform effectively with confidence.

The language used in this book is simple and easily understandable to the students at class IX level. Relevant pictorial illustrations, tables, examples and simplified concepts provided in this book help the students to learn with ease and comfort.

This book is authored by competent educationists in the field of Automobile Technology under the supervision of PSSCIVE with focus on helping the students to learn without any difficulty and use this book as a tool for easy learning.

I complement everyone who is associated in developing this book which is a very useful resource for the benefit of the students.

Comments and suggestions are welcome for further improvement of the Book.

Chairman, CBSE

Acknowledgements

Advisors

Sh. Y.S.K. Seshu Kumar, Chairman, CBSE
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Contents


BUILDING SKILLS • BUILDING FUTURE

UNIT - 1

REGULAR MAINTENANCE OF AN ENGINE

Unit Description

This unit provides introductory knowledge & skills covering vehicle servicing, specially for engine of a four wheeler. Students will be given a broad view of these important issues.

Resources Required

- Notebooks, Pen, Pencil, Eraser,
- Computer, Open Source Software for making digital presentation, LCD projector.
- Sketches, pictures, animation and videos of engine of automobiles and its components.
- Posters for building awareness about these topics.

Nominal hours: 80 Periods

Elements and Performance Criteria

- Elements define the critical learning outcomes of a unit of competency.
- Performance criteria specify the level of performance required to demonstrate the achievement of the Competency Element.

Element of Knowledge	Performance Criteria
Inspection of an Engine	• Able to trace different leakages like those of oil, coolant and combustion gases
Washing of an Engine	• Able to wash an engine externally • Able to handle the washing equipment • Able to follow appropriate precautions
Tuning fuel system of an Engine	• Able to trace the fuel system in a given vehicle engine • Able to check the fuel line for leakage • Able to conduct fuel pump test and compare its reading with the service manual • Able to set carburetor for ideal speed • Able to test nozzle for pressure
Tuning of an Ignition System of an Engine	• Able to trace the primary and secondary circuit(s) • Check the terminals for loose connection. • Able to clean spark plug and distributor
Tuning Engine Lubrication System	• Able to check the level and quality of lubricating oil • Able to replace the oil and change the oil filter • Able to check the oil pressure
Tuning of Engine Cooling System	• Able to read the temperature gauge • Able to check circulation of water in cooling system • Able to trace for coolant leakage

Tightening of Fastener (Nuts/Bolts/Screws)	• Able to tight fasteners with specified torque and with sequence in the following components cylinder head, induction manifold, Exhaust manifold and engine foundation nuts and bolt
Engine Timming	• Able to understand importance of engine timing • Able to feel the sound change after tuning process

Relevant Knowledge and Skills

1. Relevant Knowledge

- Inspection of an engine
- Washing of an engine
- Tuning fuel system of an engine
- Tuning of the an ignition system of an engine
- Tuning of the engine lubrication system
- Tuning of the engine cooling system
- Tightening of fastener (Nuts/Bolts/Screws)
- Engine Timing

2. Skills

Able to do the following tasks in a vehicle

- Able to trace different leakages like oil, coolant and combustion gases
- Able to wash an engine externally
- Able to handle the washing equipment
- Able to follow appropriate precautions
- Able to trace fuel system in a given vehicle engine
- Able to check the fuel line for l ges
- Able to conduct fuel pump test and compare its reading with service manual
- Able to set carburetor for ideal speed
- Able to test nozzle for pressure
- Able to trace the primary and secondary circuit(s)
- Check the terminals for loose connection.

- Able to clean the spark plug and distributor
- Able to check the level and quality of lubricating oil
- Able to replace the oil and change the oil filter
- Able to check the oil pressure
- Able to read temperature gauge
- Able to check circulation of water in cooling system
- Able to trace for coolant leakage
- Able to tight fasteners with specified torque and with sequence in the following components; cylinder head, induction manifold, Exhaust manifold and engine foundation nuts and bolt
- Able to understand importance of engine timing
- Able to feel the change in sound after tuning

Assessment Plan

Session No.	Assessment Metod	Due Date	Completion Date
1.	Fill in the Blanks		
2.	Fill in the Blanks		
3.	Fill in the Blanks		

Introduction

Driving a car can be fun, but its maintenance can be a pain. No one really enjoys the task of automobile maintenance. As long as the automobile works fine, we are happy and don't always remember to get its maintenance of done. Even if your vehicle works fine, getting its servicing and maintenance of regularly is necessary. General vehicle maintenance helps to keep it in good condition and can save your trouble of repairing or changing its major parts in the long run.

Regular oil check and change is required and can be considered as one of the most important steps to maintain your car. Vehicle owners never keeps track of when their engine needs an oil change. Old oil or insufficient oil in your engine will heat up the engine quickly and might lead to damage and other problems in your vehicle. To fix these problems you will have to pay quite a lot. To keep your automobile running efficiently and engine well maintained, a regular oil change is essential

Checking air regularly and filling air in the tyres is another important task, which is often neglected by car owners. The pressure in the tyres goes down over a period of time, but due to some leak, it might go down even sooner. Air in tyres should be filled in correct proportion. If tyres have insufficient air, they will wear out faster. In the case of less air, the tyres touches the road and the rim of car, which will spoil the treads of tyres. Overfilling of tyres without using a gauge might cause your tyres to burst and this can be very dangerous. Tuning up your motor on a regular basis will save you from a sudden shock and expense if costly parts in your car fail. Regular check-up of your car will keep you updated on the performance of your car and car parts. In this unit we will go through all the maintenance procedure for a vehicle.

Session - 1 : Inspection of an Engine

Relevant Knowledge

When it comes to a car, the most important component is its engine. The engine can well be regarded as the soul of a car. In fact, you might have the most well-maintained and sparkling set of wheels in your neighborhood, but if its engine is not working, it is as good as waste. In order to make sure that your car has a long life, you need to undertake regular maintenance of the engine. As we know, engine is a power producing unit of an automobile, there fuel is burned to create heat energy and that heat energy is converted into kinetic energy. Engine is a complex unit of different parts, which work together and

produces power for the movement of a vehicle.

Various types of leaakages take place in an engine, and it is a very important element of regular vehicle checkup.

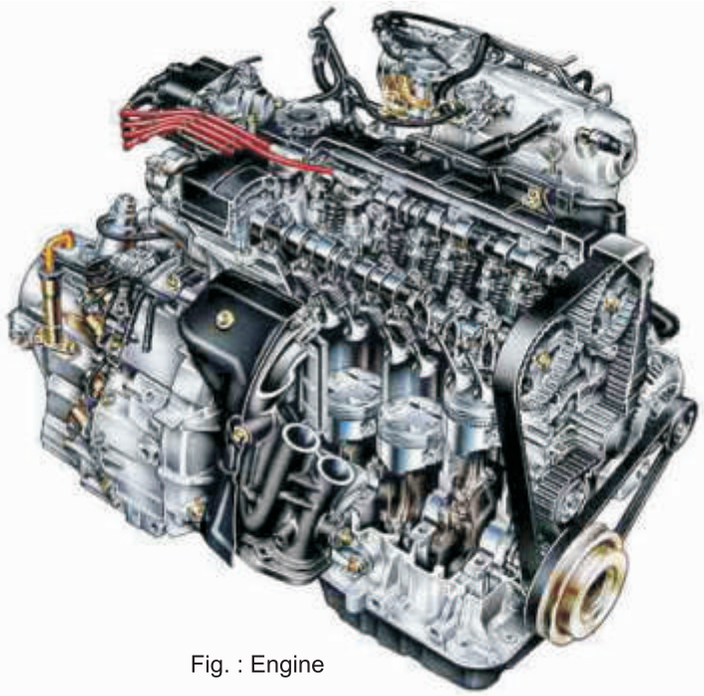

Fig. : Engine

- The leakage of combustible gases will reduce millage and pickup.
- The leakage of coolants leads to, increased engine temperature and may causes engine overheating, due to which the components will deteriorate faster
- The leakage of the lubricating oil will increase the friction and engine will reduce power output. So it is necessary to regularly inspect for the leakage and if traced then the leakage must be repaired to avoid failure of an engine.

Procedure to check the leakage in the vehicle

- Keep the vehicle on hard surface
- Open the engine bonnet and support with lever
- Adopt the following process for the checking of the leakages

(A) Cooling system leakage

When, we notice greenish colour near/ below mentioned points, it indicates that, there are chances of coolant leakage.

- Inspect coolant tank and its connections.
- Inspect radiator hose clips for looseness and if noticed leakage, tighten the clips.
- Check hose pipe for distortion/ deterioration and replace.
- Inspect radiator cap, neck and radiator core for coolant leakage.
- Inspect for torn thermostat housing gasket for leakage.
- Inspect for water pumps seal and gasket for leakage of coolant.

(B) Fuel leakage

Fuel leakage can be easily checked by smell and leakage of fuel. It reduces mileage of vehicle.

The causes of fuel leakage can be

- Evaporation of fuel
- Broken or loose fuel line connection

Following areas must be inspected for fuel leakage

- Fuel tank out let and tank cap/ rubber washer
- Flexible fuel line for slackness
- Torn fuel filter gasket or loose fuel filter
- Fuel pump connections and connectors
- Loose connection at nozzle/ carburetor areas

(C) Combustion gases leakage

The leakage of combustion gases may be traced when black soot is noticed around following areas on an engine

- Cylinder head and cylinder block
- Torn cylinder head gasket

- Spark plug /nozzle
- Engine induction and exhaust manifold
- Value guide/ improper tappet clearance

(D) Lubricating oil leakage

The leakage of lubricating oil can be traced by simple method.

- Place a newspaper below the engine
- Now run the engine for 5 min (do not move the vehicle)
- The leakages will be traced on the newspaper as spots will be observed
- Exactly perpendicular to the spot noticed will be the area of leakage.
- Stop leakage by changing the gasket oil seal etc.
- Note down the area of leakage in the table given below

Sr. No.	Name of area of Leakage

Session - 1 : Inspection of an Engine
Exercise : Assignment

1. List the types of leakages found in an engine

Sr. No.	Name of area of Leakage

2. Prepare a diagram of an engine of a vehicle.

Session - 1: Inspection of an Engine

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1) For fuel leakage following areas _____, _____, _____ must be checked in the engine.
2) Check hose pipe for _____/ deterioration.
3) Inspect radiator cap, neck and radiator core for _____ leakage.
4) Inspect radiator hose clips for _____ , if noticed leakage _____ the clips

Session - 1: Inspection of an Engine

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for maintenance of engine.

Part A

Share importance of leakages in an engine.

Part B

Discussed in class the following:

- Why leakages must be controlled?
- What are the steps to be followed while checking the leakages in engine?

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of inspection of engine		
Able to list general steps during inspection of engine		

Session - 2: Washing of an Engine

Relevant Knowledge

The modern automobile is equipped with latest technology. So, while providing services like engine washing, proper care must be taken to avoid the damages to the components as, they are very expensive. The latest engines are compact and fitted in the small area. It is necessary to clean the engine at regular intervals to remove oily layers, depositions of muck (mud and water) which may causes engine heating and changes in engine performance.

Material and equipment required to clean engine

- Car washer
- Compressor
- Diesel sprayer gun etc

Steps to clean/wash the engine

- Keep the vehicle on hard surface
- Open the engine bonnet/cover and support it properly
- Inspect for external leakage of oil, coolant, gases locate the area
- Allow the engine to reach atmospheric temperature.
- Disconnect negative terminal of battery for safety
- Now use diesel sprayer and spray the diesel only on oily layer of an engine.
- Now operate the car washer and set the water

Fig.: Automatic Car washing Unit

spraying nozzle at low pressure.

- Spray water and remove the oily layers and muck water from an engine
- Now, take some liquid soap and apply the soap slowly in the area where the hand can reach
- Again, with low water pressure, clean the engine externally
- Also clean the bonnet area and engine room
- Now, start the compressor and give air pressure to remove the water from the electrical and electronic gadgets
- Allow the engine to dry
- Connect the battery terminal and start the engine and check for smoother working

Precautions

- Do not use high pressure to clean engine
- Safeguard sensors, spark plugs, nozzle, and electronic gadgets from water
- Do not give water pressure when engine is in running condition
- Do not clean the engine when engine is hot
- Do not blow air at high pressure

Session - 2 : Washing of an Engine
Exercise : Assignment

1. List of the elements of safeguard during engine washing.

Sr. No.	Assignment

2. Prepare a diagram of car washer.

Session - 2 : Washing of an Engine

Answer the following questions
(Use additional sheets of paper if necessary)

Fill in the blanks

1) Latest engines are compact and fitted in the small area.
2) _____is used for washing the engine.
3) Spray _____ and remove the oily layers and muck water from an _____.
4) Liquid soap should be applied slowly in the _____ where the hand can reach.
5) Do not clean the _____ when engine is hot.

Session- 2 : Washing of an Engine
Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for washing of an engine.

Part A
Share importance of washing of an engine.

Part B
Discussed in class the following:

- Why washing is necessary?
- What are the steps to be followed while washing the engine?

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of washing		
Able to list general steps during washing of engine		

Session - 3 : Tuning Fuel System of an Engine

Relevant Knowledge

One of the basic components of a car comprises of its engine and talking about the car engine, its fuel system needs to be properly taken care of. In fact, proper car maintenance is as good as incomplete without adequate maintenance of the fuel system. Taking proper care of the fuel system will ensure that, your car does not consume extra fuel, runs smoothly and does not suffer from frequent breakdowns.

Tuning : The final and finest adjustment at recommended interval to maintain originality in performance of an engine is called tuning.

Every new engine gives better mileage and good performance to achieve high and low speeds in variation with load. But, after certain intervals due to vibration etc normal wear of components take place. So, it is necessary to inspect and adjust the following systems of an engine;

- Fuel system
- Ignition system
- Cooling system
- Lubrication system
- Mechanical system

Tuning of fuel system of an engine

As we have seen the sound of an engine, it should be maintained to its original level. If there

is less fuel supply the engine performance will change and it will make a noise while running. To avoid this situation, it is necessary to tune the fuel system of a vehicle.

Steps for fuel tuning

- Clean the air cleaner and fuel filter
- Remove the tank cap
- Inspect the rubber washer
- Clean the vent hole to maintain atmospheric pressure on the fuel
- Now inspect the fuel line for leakage and if flexible fuel line is damage, replace immediately
- Inspect the suction/vacuum of fuel pump
- Check the fuel pump pressure
- Compare reading with specification as specified in the service manual

Setting idle speed of an engine

- Warm up the engine and turn the idle speed screw in clock wise direction so the engine rpm will increase.
- Now slowly turn idle speed screw in the anti clock wise direction till you get the prescribed rpm
- Use tachometer to read rpm
- Now, turn the air screw in clockwise direction so that the engine will stop
- Slowly open the screw and start the engine till we get recommended rpm of an engine

Nozzle pressure test

- Remove the injector/nozzle from an engine
- Hold container below the injector/nozzle
- Connect the fuel pipe to the nozzle and start the engine
- Observe the injector/nozzle spray, if proper fix it back to the cylinder head
- Repeat for all cylinders

(If pressure is noticed less than it is necessary, calibrate the FIP pump)

Precautions

- Do not pull out the flexible pipe connection
- Do not over tighten the fuel line connection

- Do not twist the fuel line
- Do not work on fuel system with flame/spark
- Change the gaskets to avoid evaporation of fuel after regular intervals

Session - 3 : Tuning Fuel System of an Engine
Exercise : Assignment

1. List the elements of safeguard during engine washing

Sr. No.	Steps Used

2. Prepare a diagram of a vehicle.

Session - 3 : Tuning Fuel System of an Engine
Answer the following questions

(Use additional sheets of paper if necessary)
Fill in the blanks

1) _____is used as fuel in the vehicle.
2) Warm up the _____ and turn the idle speed screw in _____ direction so the engine rpm will increase.
4) Use _____ to read rpm
5) Injector/nozzle is used in an _____.

Session - 3 : Tuning Fuel System of an Engine
Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for tuning fuel system of an engine.

Part A
Share importance of tuning fuel system of an engine.

Part B
Discussed in class the following:

- Why tuning is necessary?
- What are the steps to be followed while tuning the fuel system?
- Advantages of tuning.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of tuning		
Able to list general steps during Tuning of a fuel system		

Session - 4 : Tuning of Ignition System of Engine

Relevant Knowledge

The ignition system plays an important role in process of combustion. The system converts current from 12volt to 20,000 volt. To ignite the charge, the weak or the advance spark/retarded spark will change the process of combustion and will lead to imbalanced combustion which will affect engine performance. Due to which engine tune will also change. The thin wires and their connections will supply the current between 12 volt and are called Low Tension Leads. The wires which are thick will supply the current of 20-25,000 volt and are called High Tension Leads.

The ignition system is classified in two ways i.e. primary circuit with LT leads and secondary circuit with HT leads.

The connection from battery to ignition switch to HT coil and to the distributor C.D.I. comes under primary circuit. Whereas from distributor till sparkplug connections come under H.T leads or secondary connection.

Steps for tuning of ignition system

- Inspect the battery terminal for loose contact
- Inspect the socket connection for slackness
- Check the connection to ignition switch
- Inspect connection at primary circuit of LT lead
- Inspect the connection with pick up coil and CDI unit
- Disconnect the sparkplug connection
- Now remove the distributor cap and check the HT lead for loose connections.
- Check distributor contact point for erosion/burn
- Inspect working of spark advance mechanism
- Clean distributor cap and fix it properly
- Using appropriate spanner loosen the spark plug slowly from each cylinder

- Inspect the spark plug condition
  - Colour - black soot - rich mixture - cold engine

- Dead white soot - lean mixture hot engine
- Brownish colour - normal

- Check for eroded central electrode and make it straight to maintain air gap
- Check for deposition and clean the plug by sand blast machine or by emery paper
- Using wire feeler gauge, set the spark plug gap as per the specification
- Clean the spark plug threads
- Apply oil and check spark plug sealing gasket washer, if need replace
- To install plug, first fix it with hand
- Thread it smoothly and tighten the same with specified torque
- Connect the lead wire with plug
- Start the engine and check the engine sound and ascertain if there is any change in engine sound

Session - 4 : Tuning of Ignition System of Engine
Exercise : Assignment

1. List the steps used in tuning of ignition system.

Sr. No.	Name of area of Leakage

2. Prepare line diagram of ignition system of a vehicle.

Session - 4 : Tuning of Ignition System of Engine
Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1) The ignition system plays _____role in process of combustion and ignition system converts current from ____ to 20,000 volt.
2) Normal temperature of engine is in the range of_____and _____.
3) Ignition system is classified in two ways _____ circuit with LT leads and _____ circuit with HT leads.

Session - 4 : Tuning of Ignition System of Engine
Checklist for Assessment activity

Use the following checklist to see if you've met all the requirements for tuning of ignition system of engine.

Part A

Share importance of tuning of ignition system of engine.

Part B

Discussed in class the following:

- Why tuning of ignition system of engine is necessary?
- What are the steps to be followed while tuning of ignition system of engine?

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of tuning of ignition system of engine		
Able to list general steps during tuning of ignition system of engine		

Session - 5 : Tuning of Engine Lubrication System

Relevant Knowledge

We know that the lubrication fulfills the following purposes:

- It reduces wear/friction
- It reduces heat
- It provides cleaning of an engine parts
- It helps in giving cushioning effect
- It fill the gap

The engine lubrication system working on pressurized lubrication system. In which the oil sump stores and collects the circulated lubricating oil. Oil pump will circulate lubricating oil to lubricate engine components at recommended pressure and control by salty valve. The role of oil filter and oil strainer is to filter the circulated lubricating oil and re-circulate the same.

The lack of lubrication will lead to engine sound and also the tune of engine will changes; because of increase in friction thus it is necessary to check the lubricating oil at specified intervals. Also change the lubricating oil, if oil looses viscosity or after recommended interval of distance in km.

Tuning procedure

Slowly remove the dip stick from the sump and wipe it with cotton waste. Now check the level on the dip stick and if it is low, check the quality of oil. If it is heavy, quality of oil is better viscosity then add the oil. If the oil is black it lacks viscosity. Then change the oil and oil filter.

Fig. : Checking of Engine Oil

Changing of the oil

Bring the vehicle on lubrication bay and place the container below the drain plug
Using specified spanners, loosen the drain plug and drain the oil in container Switch on the engine for 3 seconds so that engine becomes warm. It will remove oil present in pores of engine and oil will be drained out easily
Fix the plug with a new washer and tighten the same with specified torque. Refill the lubricating oil from filler plug with the recommended quantity and quality

Fig.: Filling of Oil

Changing of oil filter

Slowly remove the oil filter.
Use rubber gasket of appropriate size and place the gasket in the housing groove.
Check the gasket is not twisted or trained.
Now, fix the new oil filter tightly at specified torque

Measuring Oil Pressure

Start and run the engine to achieve optimum temperature
Check the oil pressure on pressure gauge and compare with the service manual.

Fig.: Changing of Oil Filter

Session - 5 : Tuning of Engine Lubrication System
Exercise : Assignment

1. List the steps used in tuning of engine lubrication system.

Sr. No.	Steps Used

2. Prepare a line diagram of engine lubrication system of vehicle vehicle

Session - 5 : Tuning of Engine Lubrication System
Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1) _____is used for lubrication the engine of vehicle.
2) The lack of lubrication will _____ to engine sound and also the tune of engine will

_____ because of increase in _____.

3) Change the _____ oil, if oil looses viscosity or after recommended distance of _____.

Session - 5 : Tuning of Engine Lubrication System

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for tuning of engine lubrication system.

Part A

Share importance of engine lubrication in a vehicle.

Part B

Discussed in class the following:

- Why is engine lubrication necessary?
- What are the steps to be followed while checking the lubrication system?
- Leakages in lubrication systems.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of engine lubrication		
Able to list general steps during checking engine lubrication system		

Session - 6 : Tuning of Engine Cooling System

Relevant Knowledge

You must have observed in your room/home that whenever there is rise in ambient temperature we switch on the fan, AC to reduce the temperature. It becomes comfortable to do our routine work. Similarly our vehicle also works on the principle of cooling during running.

Cooling system in a car protects the engine from overheating. Cooling system removes 30% of the heat of the engine. An efficient cooling system keeps the engine protected. Rise in engine temperature may causes over heating of engine, which changes its performance. Components of the engine will get distorted and reduce its life. Hence, it is necessary to check the functioning of the cooling system at specified intervals. One must always use good quality coolant for car engine. The coolant level must be checked at least once a fortnight. During summers, it must be checked more frequently.

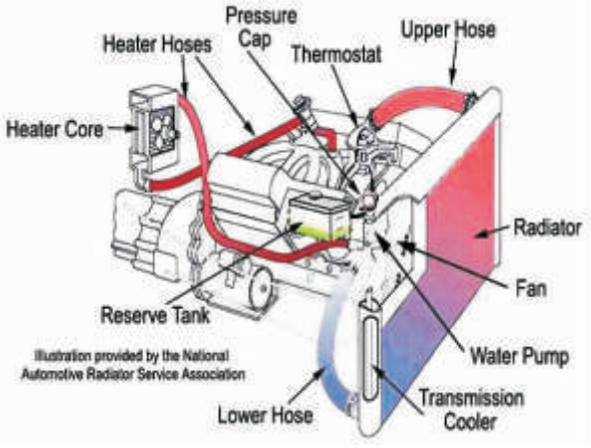

Fig : Automobile Cooling System

Steps involved in checking the cooling system
Reading of temperature gauge

Temperature gauge is fixed on dash board which regularly monitors the variation in engine temperature. Moderate temperature of engine is 75-80 degree centigrade which needs to be constantly maintained.

Parts of Cooling System

The cooling system includes the engine's water jacket, thermostat, water pump, radiator and radiator cap, cooling fan (electric or belt driven), hoses, heater core and overflow tank.

Checking Circulation of water in cooling system

- Switch off the ignition switch of vehicle
- Remove the negative terminal from the battery
- Turn the upper radiator cap slowly and allow the stem/water vapors' to release from the radiator.
- Turn the radiator cap and remove the cap from the neck of the radiator
- Connect the battery terminal and switch on the ignition.
- Run the engine at idle speed

- Inspect the circulation of water in the radiator.
- Circulation of water should be observed as rate of inlet must be equal to rate of outlet of coolant.
- This shows healthy running of coolant system.

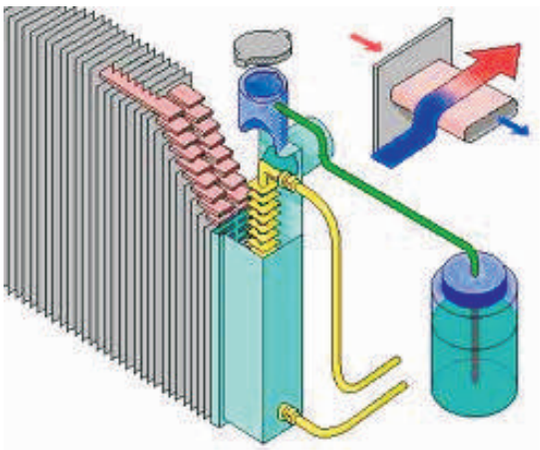

Fig : Cooling Circulation

Checking of Coolant Leakage

- Inspect coolant tank and its connections.
- Inspect radiator hose clips for looseness and if notice leakage, tighten the clips.
- Check hose pipe for distortion/ deterioration and replace.
- Inspect radiator cap, neck and radiator core for coolant leakage.
- Inspect for torn thermostat housing gasket for leakage.
- Inspect for water pumps seal and gasket for leakage of coolant.

Setting of cooling fan belt tension

- Inspect belt for cracks, cut deformation, wear and cleanliness. If necessary, change the belt
- Check belt tension as 6 - 7 mm as deflection
- To adjust the belt to tight or loose, change the position of the alternator
- Tighten belt adjusting bolt and alternator pivot bolt

Session - 6 : Tuning of Engine Cooling System
Exercise: Assignment

1. List the steps used in tuning of cooling system.

Sr. No.	Steps Used

2. Prepare a diagram of an engine of a vehicle.

Session - 6 : Tuning of Engine Cooling System
Answer the following questions
(Use additional sheets of paper if necessary)

Fill in the blanks

1. _____is used for cooling the vehicle.
2. Normal temperature of engine is in the range of_____and _____.
3. Percentage of heat removed by cooling system is _____ %.

Session - 6 : Tuning of Engine Cooling System
Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for tuning of engine cooling system.

Part A

Share importance of cooling of a vehicle.

Part B

Discussed in class the following:

- Why is cooling necessary?
- What are the steps to be followed while checking the functioning of the cooling system?
- Leakages in cooling systems.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of cooling		
Able to list general steps during checking cooling system		

Session - 7 : Tightening of Fastener (Nuts/Bolts/Screw)

Relevant Knowledge

As you know that, the engine is a complex piece of machinery in which different components are assembled by using different types of fasteners. Due to power production, transmission of power, variation in speed and load, vibration leads to loosening of fasteners. This may change the stability of components and lead to development of bending. Further, it may develop scratches, cracks, and may cause leakage of coolant and gases etc. It will affect the engine performance.

(A) Tightening of Cylinder Head, Induction Manifold and Exhaust Manifold

To avoid the combustion gases, it is necessary to tight cylinder head in following manner

- Remove the tappet cover from cylinder head
- Remove the rocker arm assembly
- Slowly remove the pushrods (overhead valve mechanism)
- Use specific size of socket spanner with appropriate torque wrench.
- Use strictly the service manual as per the prescribed sequence.
- Tighten the cylinder with specified torque.

Fig : Cylinder Head

Induction Manifold

Loose induction manifold may create vacuum leakage which leads to supply lean mixture which may causes hesitation in engine running.

- Tighten the induction manifold using specific size of socket spanner with appropriate torque wrench.
- Use strictly the service manual as per prescribed sequence.
- Inspect the induction manifold gasket.

Fig : Induction Manifold

Exhaust Manifold

Loose induction manifold may cause emission leakage and lead to cause blackening of bottom of body and may catch fire

- Tighten the exhaust manifold by using specific size of socket spanner with appropriate torque wrench.
- Use strictly the service manual as per prescribed sequence.
- Inspect the exhaust manifold gasket.

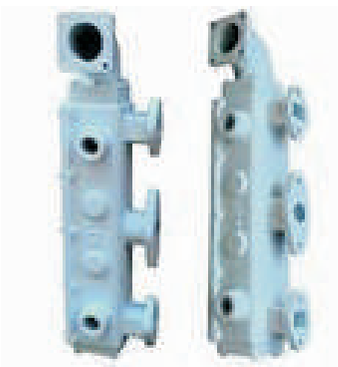

Fig : Exhaust Manifold

Material and tools requirement for tightening of fastener

- Socket spanner
- Tommey bar
- Extension bar/rod
- Torque wrench
- Torque wrench socket

Session - 7 : Tightening of Fastener (Nuts/Bolts/Screw)

Exercise : Assignment

1. List the torque required for tightening of fasteners using service manual

S.No.	Name of Components	Tightening Torque
1.		
2.		
3.		
4.		

2. Prepare a poster showing tools used in tightening of fasteners

Session - 7 : Tightening of Fastener (Nuts/Bolts/Screw)

Answer the following questions

(Use additional sheets of paper if necessary)

A. Fill in the blanks

1. Tightening is required to avoid _____.
2. Inlet manifold is used for _____.
3. Exhaust manifold is used for _____.

B. Tick the correct answer

1. Mallet is made of

A. Iron
B. Wood
C. Steel
D. Aluminum

Session - 7 : Tightening of Fastener (Nuts/Bolts/Screw)

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements tightening of fastener (nuts/bolts/screw)

Part A

- Share importance of tightening the fasteners

Part B

Discussed in class the following:

- Why tightening is important?
- What are the different types of tools used in tightening of fasteners?
- How to set the torque wrench Steps used in tightening.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to tighten the cylinder head, induction and exhaust manifold		
Able to identify general tools used to handle the fasteners		

Session - 8 : Engine Timing (Tuning)

Relevant Knowledge

To run the engine smoothly it is necessary to supply fuel by opening and closing the inlet valve, similarly it is also needed to remove the exhaust gases at right time from the cylinder. The movements of the valves are related to the crankshaft revolution and engine (otto) cycle. It is necessary to check and set valve timing.

For the process of combustion, it is necessary to ignite the charge by using sparkplug at the right time. Plug should ignite the charge at end of compression stroke. There is a need to set the ignition system in relation to rotation of crankshaft. Thus, check and set ignition timing.

Stroboscope Lamp/Gun

Fig : Stroboscope Lamp/Gun

Stroboscope is an instrument used to make a cyclically moving object (our flywheel) appears to be slow-moving or stationary. Stroboscopes are used in timing lights to dynamically set the ignition timing of an Otto cycle combustion engine. The timing light is connected to the ignition circuit (mostly inductively) and used to illuminate the timing marks with the engine running. The apparent position of the marks, frozen by the stroboscopic effect, indicates the current timing of the spark in relation to piston position.

Those tools come in various shapes, most in gun- or torch shape. All need a power supply (230V or 12V) and they have a pickup unit (mostly an induction clamp to be put around the HT cable for impulse pickup)

Fig : Tuning

In new modern vehicles, we use multipoint fuel injection system. In the process of combustion of fuel injection system, it is necessary to inject the fuel by using fuel injector. The fuel injector will inject the fuel at right time at appropriate pressure at end of compression stroke. There is a need felt to set theinjection timing (FIP) system in relation to rotation of crankshaft. Thus, check and set fuel injection trimming. Timing will maintain total functioning of the engine and governs the fuel economy.

Steps for checking of valve timing

- Remove the timing cover
- Check the alignment of the following
- Turn the crankshaft pulley with transmission belt and mark on the pulley must align with crankcase mark.
- At the same time camshaft pulley mark must align with crankcase marking. This indicates proper valve timing.

Steps for checking of ignition timing

- Connect the stroboscope connection as per manual.

- Now hold stroboscope lamp near the fly wheel and run the engine at idle speed
- Check timing mark on the flywheel matches with pointer of crankcase housing at a same time lamp must glow, shows the alignment.
- This indicate proper ignition timing

Steps for checking of injector timing

Check the alignment the FIP timing with camshaft gears/pulley which ensures injection timing

Session - 8 : Engine Timing (Tuning)
Exercise: Assignment

1. Visit the service centre and check the valve timing, ignition timing and injection timing of four types of vehicle.
2. Prepare a poster showing valve timing, ignition timing and injection timing of a vehicle.

Session - 8 : Engine Timing (Tuning)
Answer the following questions
(Use additional sheets of paper if necessary)

Fill in the blanks

1. Valve timing is used for_____.
2. Ignition timing helps _____ in an engine
3. Injection timing are used in _____.
4. Stroboscope helps in _____ of ignition timing.

Session - 8 : Engine Timing (Tuning)
Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for engine timing (tuning).

Part A

- Share importance of different timings related to engine performance.

Part B

Discussed in class the following:

- What is meaning of timing?
- What are the different between ignition and injection timing?
- Name tool used in checking engine timing.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of timing in engine coolant		
Able to check the ignition, injection and valve timing		

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	Rajput R K, Laxmi	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

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UNIT - 2

REGULAR MAINTENANCE OF TRANSMISSION SYSTEM

Unit Description

This unit provides introductory knowledge & skills covering vehicle servicing specially to regular maintenance of transmission system of a vehicle. Students will be given a broad view of these important issues.

Resources Required

- Notebooks, Pen, Pencil, Eraser.
- Computer, Open Source Software for making digital presentation, LCD projector.
- Sketches, pictures,
- Animation and videos of transmission system of an automobile and its components.
- Posters for building awareness on these topics.

Nominal hours: 40 Periods

Elements and Performance Criteria

- Elements define the critical learning outcomes of a unit of competency.
- Performance criteria specify the level of performance required to demonstrate the achievement of the Competency Element.

Element of Knowledge	Performance Criteria
Transmission system	• Able to understand the function of different units used to transmit engine power • Able to identify the different units of the transmission system • Able to clean motor cycle drive chain • Able to lubricate drive chain Able to adjust drive chain
Clutch maintenance	• Able to inspect the functioning of clutch linkage for free movement • Able to lubricate the clutch linkage • Able to tighten the fasteners as per need
Clutch adjustments	• Able to set free play adjustment of clutch • Able to set pedal travel adjustment of clutch pedal • Able to inspect the power transmission from clutch assembly

Relevant Knowledge and Skills

1. Relevant Knowledge

- Transmission system
- Clutch maintenance
- Clutch adjustments

2. Skills

Able to do/replace above items in a vehicle

- Able to understand the function of different units used to transmit engine power
- Able to identify the different units of transmission system

- Able to clean motor cycle drive chain
- Able to lubricate drive chain
- Able to adjust drive chain

Assessment Plan

Session No.	Assessment Metod	Due Date	Completion Date
1.	Fill in the Blanks		
2.	Fill in the Blanks		
3.	Fill in the Blanks		

Introduction

As you know that a vehicle is operated with an engine. Various component of an vehicle help in smooth movement of vehicle. One of the important systems of a vehicle is transmission system. The entire mechanism which transmits the power from engine to the wheel is known as transmission system. It is also called power train. This system contains the components such as clutch, gearbox, propeller shaft, differential unit etc.

For smooth operation of the transmission system, it is necessary to maintain properly. We have to properly check the all important components of a vehicle.

In this Unit, you will develop an understanding of the transmission system role so that vehicles efficiency increases

Session - 1 : Transmission System

Relevant Knowledge

The entire mechanism which transmits the power from the engine to the wheel is known as the transmission system. It is also called power train. This system contains the following components, which are given below with their functions.

Clutch: This engages and disengages transmission from driving member/shaft to driven member, which assists the gradual engagement and disengagement in transmission of

power. In the engage position, clutch must transmit the total engine torque to the gearbox.

Gearbox/Transmission: To overcome the resistances like gradient resistance, air resistance and load resistance, it is necessary to increase the tractive effort. We use gearbox in transmission by changing the gear ratios which overcome the resistances. It is placed between clutch and propeller shaft/differential.

Propeller Shaft: To transmit the power with variation of the angle and variation in length in relation with front and rear axle, the propeller shaft is used; this is connected between gear box and final drive.

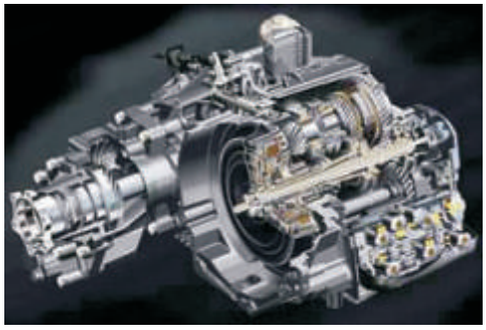

Fig : Gear Box

Differential Unit: A vehicle's wheels rotate at different speeds, mainly when turning corners. The differential is designed to drive a pair of wheels while allowing them to rotate at different speeds. In vehicles without a differential, such as karts, both driving wheels are forced to rotate at the same speed, usually on a common axle driven by a simple chain-drive mechanism. When cornering the inner wheel needs to travel a shorter distance than the outer wheel. In automobiles and other wheeled vehicles, a differential allows th driving road wheels to rotate at different speeds. This is necessary when the vehicle turns, making the wheel that is travelling around the outside of the turning curve roll farther and faster than the other.

Cleaning of motorcycle driving chain

- To increase the life of sprockets and driving chain rollers, it is necessary to follow the given sequences for cleaning;
- Remove the chain cover from the motorcycle
- Turn the wheel and by using nose pliers, remove chain lock
- Takeout the chain from both the sprockets
- Using diesel, clean thoroughly clean the chain and sprockets.
- Now, wipe out the chain and place it in SAE 90 grade lubricating oil.
- Now place the chain on the sprockets.
- Slowly turn and check for free rotation.

If the chain is loose

- Loosen the rear wheel axle nut and also use the crushed drive plate nut
- Tighten the adjusting nut equally on both the sides, wheel will come back and chain will be tight
- There must be slackness of 8-10 mm, because while riding the chain will be stressed.

Session - 1 : Transmission System

Exercise: Assignment

1. Identify and locate the different units of transmission system and fill the table.

Sr. No.	Name of Component	Function

2. Prepare a poster showing the line diagram of transmission system

Session - 1 : Transmission System
Answer the following questions
(Use additional sheets of paper if necessary)

Fill in the blanks

1. Component of transmission system are_____ and _____.
2. Propeller shaft helps _____ in an engine
3. Function of differential unit are _____.
4. Clutch assembly helps in _____ of _____.

Session - 1 : Transmission System
Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for transmission System.

Part A

- Share importance of different components of transmission system of a vehicle.

Part B

Discussed in class the following:

- What is the importance of transmission system ?
- What are the difference between clutch and gear.
- Clutch Pedal Travel Adjustment.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of transmission system		
Able to identify the componets of transmission system		

Session - 2 : Clutch Maintenance and Adjustment
Relevant Knowledge

Clutch Maintenance

Clutch requires regular maintenance and lubrication in easy shifting of gears and clutch must also transmit total engine torque.

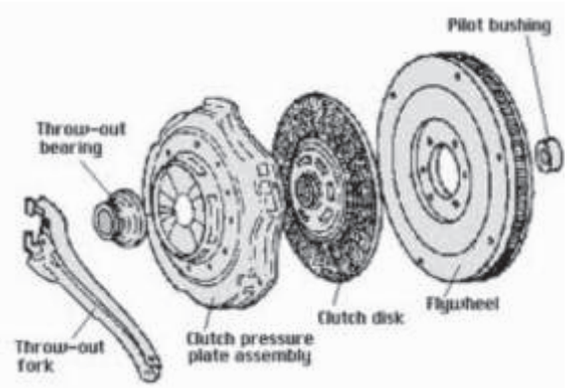

Fig. : Clutch Components

Operate the clutch lever/pedal and see, clutches fully disengages transmission of power from an engine.

When the clutch is engaged, ensure that it transmits the power completely without any slippage. For this purpose, there should not be any pivot friction in control cable connection or in clutch linkage. At regular intervals, clean and lubricate the linkage points and joints.

Also tighten the slacken nut and fasteners to specified torque and ensure friction free movement of the clutch mechanism.

Clutch adjustments

For healthy running of clutch, the following adjustments are to be carried out

Free Play adjustments (Two Wheelers)

- First check the free play of clutch lever, which should be 10-12 mm. If the free play is incorrect then adjust
- Stretch the outer cable/sleeve by loosening the locknut and turning the tubular screw (adjustment unit) anti clockwise to reduce the freeplay and clock-wise to increase the play.
- If the clutch play is not able to adjust by stretching of outer cable the adjust the play by tightening the inner cable attachment with the clutch near gear box.

Free Play adjustments (Four Wheelers)

The adjustment depends on the make of the four wheeler. The clutch free play for four wheeler is generally 15-20 mm at the clutch pedal. If the free play is less or more than the specified, it is to be adjusted in the following way (for heavy vehicles)

- Loosen the lock nuts on both side of turn buckle.
- Rotate the turn buckle according to the requirement to adjust the required play at the clutch pedal.
- After adjustment, tighten the lock nut

Clutch Pedal Travel Adjustment

- Operate the clutch pedal and inspect it
- Clutch pedal must travels freely on the floor board
- Carry out the necessary adjustments by adjusting the clutch linkages and adjustable sleeves.

Inspect power transmission from clutch assembly

- Start the engine and run at idle speed
- Now operate the clutch and check variation in noise
- Now engage the gears and slowly release the clutch
- Notice for smooth transmission power without any jerky movement
- Sift the next gear, check for the smooth sifting and hundred percentage transmission of power.

Session - 2 : Clutch Maintenance and Adjustment

Exercise: Assignment

1. Identify and locate the different component of clutch.

Sr. No.	Name of Component	Function

2. Prepare a poster showing the clutch.

Session - 2 : Clutch Maintenance and Adjustment

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1. Clutch is used for_____ and _____ power.
2. Less free play causes _____ in an engine.
3. Clutch unit is fixed between _____ and_____.
4. Clutch assembly helps in _____ of _____.

Session - 2 : Clutch Maintenance and Adjustment

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for clutch maintenance and adjustment.

Part A

- Share importance of different parts of clutch used in a vehicle.

Part B

Discussed in class the following:

- Importance of clutch
- Importance of free play adjustment
- Effects of binding in clutch
- What are the difference between clutch and gear
- Clutch pedal travel adjustment.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of clutch maintenance and adjustment.		
Able to identify the components of clutch.		

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	Rajput R K, Laxmi	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

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UNIT - 3

REGULAR MAINTENANCE OF GEAR BOX

Unit Description

This unit provides introductory knowledge & skills covering vehicle servicing specially to regular maintenance of transmission system of a vehicle. Students will be given a broad view of these important issues.

Resources Required

- Notebooks, Pen, Pencil, Eraser.
- Computer, Open Source Software for making digital presentation, LCD projector.
- Sketches, pictures.
- Animation and videos of transmission system of an automobile and its components.
- Posters for building awareness on these topics.

Nominal hours: 30 Periods

Elements and Performance Criteria

- Elements define the critical learning outcomes of a unit of competency.
- Performance criteria specify the level of performance required to demonstrate the achievement of the competency element.

Element of Knowledge	Performance Criteria
Lubrication of gear box	• Able to check the level of lubricating oil and quality of oil in the gear box • Able to change the lubricating oil from the gearbox

Setting of gears	• Able to check the various combination of gears • Able to set gear lever and selecting mechanism • Able to check the power transmission through respective gears

Relevant Knowledge and Skills

1. Relevant Knowledge

- Lubrication of gear box
- Setting of gears

2. Skills

Able to do/replace above items in a vehicle

- Able to check the level of lubricating oil and quality of oil in the gear box
- Able to change the lubricating oil from the gearbox
- Able to check the various combination of gears
- Able to set gear lever and selecting mechanism
- Able to check the power transmission through respective gears

Assessment Plan

Session No.	Assessment Method	Due Date	Completion Date
1.	Fill in the Blanks		
2.	Fill in the Blanks		
3.	Fill in the Blanks		

Introduction

Gear system forms an important component of a car and thus, requires proper handling and attention on your part. Since, they help you to maintain the speed of your car, you

cannot afford to misuse the gears. While changing the gears, it is very important that the clutch should be completely pressed.

At the same time, you need to make sure that the clutch is properly adjusted for free pedal movement and smooth gear change. There are some other maintenance tips as well, that, you need to keep in mind, to ensure a long life of the gear system.

In this Unit, you will develop an understanding of the gear box maintenance at regular intervals so that the vehicle's efficiency increases.

Session - 1 : Lubrication of Gear Box

Relevant Knowledge

Gearbox: To overcome resistances like gradient resistance, air resistance and load resistance, it is necessary to increase the tractive effort. We use gearbox in transmission by changing the gear ratios which overcome the resistances. It is placed between the clutch and propeller shaft/differential. When gear box increases tractive efforts in transmission of power, heat is produced in meshing gears and contact surface area between meshing gear teeth comes under heavy friction.

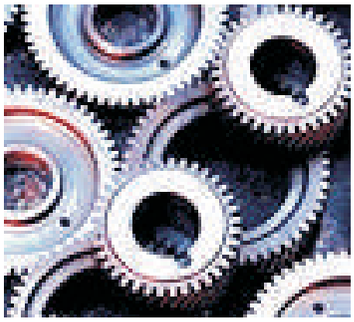

Fig: Gear

Lubricating oil reduces friction and also provides a cushioning effect, when clutch shaft transmits the drive to the counter shaft and then power is transmitted to the main shaft gear. The selective mechanism locks the respective gears as per the requirement (gear ratio) and then power is transmitted through the main shaft. In this transition, selective mechanisms, gear wheel, gear shaft splines, gear teeth develop friction and heat. To sustain the life of these components, it is necessary to lubricate these parts and change the lubricating oil at specified intervals. In motorcycles, lubricating oil is changed at 2,000-3,500 kms whereas, in cars lubricating oil is changed at 10,000-15,000km.

Steps for changing lubrication of gear box

- Check for leakage of oil from the gearbox and check and clean the air breathers

- Check the level of lubricating oil in the gearbox by loosening the oil level bolt which is placed at the side of gearbox.
- When the gearbox is filled with correct quantity of oil, it starts to flow through the level hole.
- To check the quality of oil in the gearbox, the following procedure may be adopted:
  - Take a drop of used oil and place it on the nail of thumb, while the thumb is being held vertically upward in this position. Check the viscosity of old lubricating oil (flow of oil) in the downward direction. Similarly, check the flow for new oil, on other hand's thumb nail, and compare the resistance to flow for both old and new oil. Used oil flow will be faster in comparison to new oil.
  - Check the oiliness quality of the oil by rubbing continuously on the hand skin. The old oil will be smelling of used oil. The burning smell should not come from oil.
  - The quality also can be checked by smelling used oil. The burning smell should not come from oil.

Changing of the lubricating oil

- Run the vehicle for 2-3 km
- Place the vehicle at lubbay
- Place the container below the drain plug of gearbox
- Open the filler and drain plug and leave it for appropriate time, so that oil is completely drained out
- Replace the washer of drain plug and tighten it to the specified torque.
- Refill the gear oil of specified grade and quantity up to the level mark
- Close the level/ filler plug.

Session - 1 : Lubrication of Gear Box
Exercise : Assignment

1. Check the viscosity and oiliness of lubricating oil
2. Prepare a poster showing filling of lubricating oil in gear box in a vehicle.

Session - 1 : Lubrication of Gear Box

Answer the following questions

(Use additional sheets of paper if necessary)

Fill in the blanks

1) Lubricating oil is used for_____.
2) Lubrication removes _____ from engine
3) Lubricating oil should be changed at every _____ year.
4) Replace the _____at the manufacturer recommended interval.

Session - 1 : Lubrication of Gear Box

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for lubrication of gear box

Part A

Share importance of lubrication of gear box

Part B

Discussed in class the following:

- What is meaning of gear box?
- What are the differences between oil and coolant?
- Name tools used in changing coolant in vehicle.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of lubrication of gear box.		
Able to identify gear box and its components		

Session - 2 : Setting of Gear Box

Relevant Knowledge

For easy shifting of gears, it is necessary to regularly lubricate the gear linkages. Slackness must be inspected and adjusted at regular intervals otherwise, it may cause hard gear shifting and gear slips out of mesh. To avoid this problem, it is necessary to inspect the alignment of the following parts:

Gear lever with gear rod-excessive play is adjusted by using thrust washer, by adding thrust washers in gear lever casing. Also, check the gear rod spring and lever ball for wear. Gear shifter fork should align with shifting sleeve on the main shaft of respective gear. If alignment is improper, loosen the fork bolt and adjust the

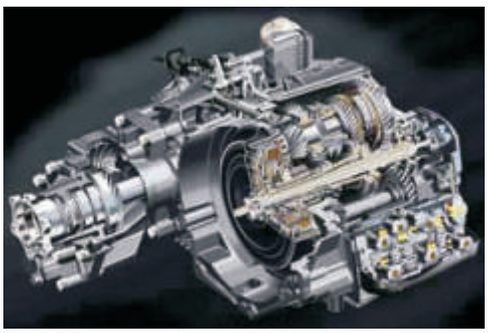

Fig: Gear Box

Check the synchronizing ring with the synchronizing cone and with fixed hub mounted on main shaft. Inspect the internal and gear teeth for nick formation, polish the same for solving the problem. In case of motorcycles, tighten the gear shifter lever, if it has slackened.

Fig: Gear Shifter Fork

Go for road test after the service and check for the following

- Gear shift easily from 1 to 5 gears and reverse with appropriate speed and resistance.
- Check for smooth power transmission

Session - 2 : Setting of Gear Box
Exercise : Assignment

1. Identify and list the gear selective mechanism
2. Give the reasons for hard gear shifting
3. Prepare a poster showing synchronizing gear box selective mechanism

Session - 2 : Setting of Gear Box
Answer the following questions
(Use additional sheets of paper if necessary)

Fill in the blanks

1) More play in gear linkage causes_____.
2) If there is nick on gear teeth, will causes _____
3) Lubricating oil should be changed at every _____ km.
4) Replace the _____at the manufacturer's recommended interval.

Session - 2 : Setting of Gear Box
Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for setting of gear box.

Part A

Share importance of setting of gear box.

Part B

Discussed in class the following:

- What is function of gear box?
- What are the different combinations in gearbox?
- Name tools used in sifting in gear

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of checking play in gear box.		
Able to identify gear box and its components.		

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	Rajput R K, Laxmi	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

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www.bikeadvice.org
www.wikipedia.com
www.shell.com/home/content/ind/products_services/on_the_road

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UNIT - 4

SERVICING OF THE WHEELS

Unit Description

This unit provides introductory knowledge & skills covering vehicle servicing, specially for engine of a four wheeler. Students will be given a broad view of these important issues.

Resources Required

- Notebooks, Pen, Pencil, Eraser,
- Computer, Open Source Software for making digital presentation, LCD projector.
- Sketches, pictures, animation and videos of wheels stud and its components.
- Posters for building awareness about these topics.

Nominal hours: 40 Periods

Elements and Performance Criteria

- Elements define the critical learning outcomes of a unit of competency.
- Performance criteria specify the level of performance required to demonstrate the achievement of the Competency Element.

Element of Knowledge	Performance Criteria
Importaaznce of wheel	• Able to identify different types of wheels • Able to list the functions of wheels
Importance of hub greasing and bearing play adjustments	• Able to remove the wheels from axle • Able to remaove the hub • Able to replace wheel stud • Able to clean the wheel bearing • Able to do greasing of hub and wheel bearing • Able to adjust wheel play (Bearing) adjustment

Relevant Knowledge and Skills

1. Relevant Knowledge

- Importance of wheels
- Importance of hub greasing and bearing play adjustments

2. Skills

Able to do/replace above items in a vehicle

- Able to identify different types of wheels
- Able to list the functions of wheels
- Able to remove the wheels from axle

- Able to remove the hub
- Able to replace wheel stud
- Able to clean the wheel bearing
- Able to do greasing of hub and wheel bearing
- Able to adjust wheel play (Bearing) adjustment

Assessment Plan

Session No.	Assessment Method	Due Date	Completion Date
1.	Fill in the Blanks		
2.	Fill in the Blanks		
3.	Fill in the Blanks		

Introduction

Though a large number of car owners are unaware of the fact, car tyres have an important bearing on the performance and safety of the car. In fact, when car maintenance is the question in point, ensuring that the tyres are in good condition, is an issue that very important. Old and worn out tyre can easily lead to skidding of the vehicle and endanger your life as well as your car. In order to help you take proper care of your car tyres. You should properly check the all important components of the car.

In this Unit, you will develop an understanding of the wheel of a car. Importance of hub greasing and bearing play adjustments of a vehicle so that vehicle's efficiency increases.5

Session - 1 : Importance of Wheels

Relevant Information

Without an engine car may be towed, but it is not possible to move the car without the wheel and tyre. If something happens to our legs, we will be unable to walk properly. Similarly, if something happened to the wheels, it will stop at the same place till we provide the some help and repair work.

Various requirements of an automobile wheel are given below:

- To take the vehicle load, wheels with tyres gives a cushioning effect, it must cope up with steering system or it should take side thrust/cornering effects and also withstand driving thrust (able to transmit the power at specified load).
- It should be light in the weight so that unsprung weight is least. It should be removed easily and mount easily.

Types of wheels

Following types of wheels are used in automobile

- Disc wheels
- Light alloy cast or forged wheels
- Alloy wheels

Fig: Disc Wheel

Disc wheels: These type of wheels consist of two parts, steel rim which is generally well-based to receive the tyre and pressed steel disc. Steel disc is welded to the rim. It is light in weight. It is used in heavy vehicle like trucks, buses etc.

Fig: Alloy Wheel

Light alloy cast or forged wheel: These type of wheels are used for the cars. Wheels are made of aluminum alloy which is a better conductor of heat, which disperses heat in application during rolling wider rim improves stability on cornering.
(while taking a turn).

Session - 1 : Importance of Wheels
Exercise : Assignment

1. Market Survey and fill the chart

Sr. No.	Name of Vehicle	Type of Wheels

2. Prepare a poster showing different types of wheel.

Session - 1 : Importance of Wheels
Answer the following questions
(Use additional sheets of paper if necessary)

Fill in the blanks

1) Wheels is used for_____.
2) Wheels are fitted in front and_____ of engine.
3) Alloy wheels are used in _____.
4) Disc wheels are used in_____.

Session - 1 : Importance of Wheels

Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for importance of wheel.

Part A
Share importance of wheels.

Part B
Discussed in class the following:

- The Importance of wheel?
- What are the differences between disc wheels and alloy wheels?
- Name tools used in changing the wheels.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of wheel		
Able to identify different types of wheel		

Session - 2 : Importance of Hub Greasing and Bearing Play Adjustments

Relevant Knowledge

For friction free rotation of wheels, it is necessary to lubricate, the wheel hub and wheel bearing at specified intervals. Bearing grease is used to lubricate these items.

Fig: Wheel Stud

Wheel hub: Wheel hub is a single casted unit mounted on stub axle shaft or on the casing. It consists of two taper roller bearings in which spacer is placed between two bearings. It holds break

drum and wheel. Measure function of wheel hub is to rotate freely on stationary shaft/casing. It is fastened by the castled locknut on the axle/casing. During adjustment of bearing end play, shimps will be added to reduce the axle play. Wheel studs are fastened with wheel hub.

Fig: Wheel Hub

Stub axle: Front main axle is connected to stub axle. Stub axle holds the wheel hub.

Steps for removing wheel from axle

- Place wooden blocks to the wheels to lock the wheel.
- Loosen the wheel nuts by using wheel spanner
  Lift the vehicle up using hydraulic jack under the front axle and make it rest on stands. Remove the jack
- Remove the grease cup with the help of hammer and screwdriver.
- Straighten the split pin and take out by using combination plier.
- Unscrew the castle nut and take it out.
- Remove the brake drum from stub axle
  Remove the wheel and hub from stub axle

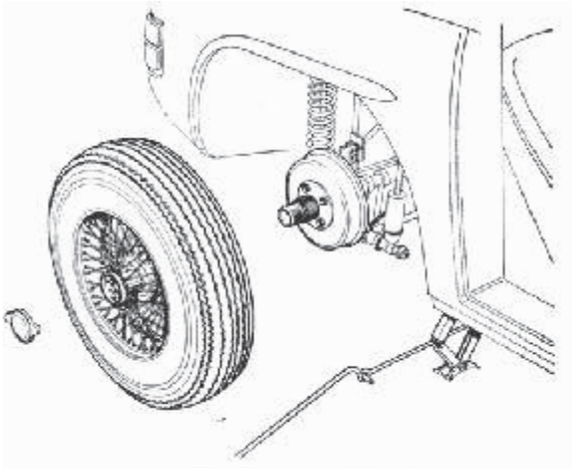

Fig: Removing Wheel

Steps for cleaning the wheel bearings

- Remove the taper roller bearing from the hub and axle shaft.
- Take diesel oil in a tray and pour diesel oil in bearing.
- Taking rubber pad, splash the grease from bearing.
- Thoroughly clean the bearing, hub and axle shaft
- Big and small taper roller bearings are checked for being worn out and assurance of no play and abnormal wear etc
- Wipe it out with dry clean cloth

- Now take the fresh bearing grease and fill it from broader side of taper roller bearing.
- Ensure grease reaches to the opposite side of the wheel.
- Now fix the bearing on the axle shaft with spacer.
- Fill the grease in the hub.
- Change the outer and inner grease seals.
- Fix the castle nut and tighten it to the specified torque.

Steps for adjusting wheel play

- Place washer and tightened the castle nut.
- Check the wheel by turning.
- If there is friction, loosened the castle nut.
- Check again for friction.
- Wheel should roll freely.
- Lock the castle nut with the use of spilt pin.
- Fit the grease cup by filling with new grease.
- Lift the vehicle with jack and take out the stand
- Remove the jack by lowering it down.

Steps to remove the broken studs from the hub

- Due to over tightening, overloading of vehicle may cause wheel nut, stud to break.
- Use stud extractor or by using hand drill machine remove the broken stud without damaging the internal threads of hub. Use tap to redress internal threads of the hub.
- Choose new stud of proper size and fix in the hub.

Precaution

- Over filling the grease in centre of the hub is not advisable, as it will flow out due to heat and may go in brake drum.
- Oil seal should be replaced if needed.
- To allow the free movement of wheel and no play, the castle nut should be first tightened and loosened by a quarter or half thread.
- Castle nut must be locked by placing proper sized split pin.
- Grease cup should not be overfilled.

Session - 2 : Importance of Hub Greasing and Bearing Play Adjustments
Exercise : Assignment

1. List places of bearing in the hub.
2. Identify and locate the different component of clutch.

Sr. No.	Type of vehicle	Bearing places

3. Prepare a poster showing stud in hub in a vehicle.

Session - 2 : Importance of Hub Greasing and Bearing Play Adjustments
Answer the following questions
(Use additional sheets of paper if necessary)

Fill in the blanks

1) Stud is used to hold_____.
2) To remove the stud _____ is used.
3) _____ is used in the bearing.
4) Replace the _____when it is broken.
5) Dress _____of the thread.

Session - 2 : Importance of Hub Greasing and Bearing Play Adjustments

Checklist for Assessment Activity

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

Part A
Share importance of hub greasing.

Part B
Discussed in class the following:

- What is meaning of hub greasing?
- What are the differences between wheel hub and wheel axle?
- Name tools used in opening of wheel hub in a vehicle.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of hub grease.		
Able to identify broken stud.		

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	Rajput R K, Laxmi	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

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www.automobileindia.com/consumer-guide/automobile-technology
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www.shell.com/home/content/ind/products_services/on_the_road

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UNIT - 5

REGULAR MAINTENANCE OF TUBES AND TYRES

Unit Description

This unit provides introductory knowledge & skills covering vehicle servicing, specially with regard to regular maintenance of tubes and tyres of vehicle. Students will be given a broad view of these important issues.

Resources Required

- Notebooks, Pen, Pencil, Eraser,
- Computer, Open Source Software for making digital presentation, LCD projector.
- Sketches, pictures, animation and videos of tube and tyres of automobiles and its components.
- Posters for building awareness about these topics.

Nominal hours: 40 Periods

Elements and Performance Criteria

- Elements define the critical learning outcomes of a unit of competency.
- Performance criteria specify the level of performance required to demonstrate the achievement of the Competency Element.

Element of Knowledge	Performance Criteria
Tyres and their maintenance	• Able to measure air pressure in tyres as per specifications • Able to rotate tyres as normal wear
Tyre puncture	• Able to repair of punctured tube with hot patch, cold patch • Able to repair the puncture of a tubless tyre

Relevant Knowledge and Skills

1. Relevant Knowledge

- Tyre and their maintenance
- Tyre puncture

2 Skills

Able to do/replace above items in a vehicle

- measure air pressure in tyre as per specifications
- rotate tyres for normal wear
- repair of punctured tube with hot patch, cold patch method
- do repairing of puncture of tubeless tyres

Assessment Plan

Session No.	Assessment Method	Due Date	Completion Date
1.	Fill in the Blanks		
2.	Fill in the Blanks		
3.	Fill in the Blanks		

Introduction

Whenever we plan to go out from our home, we need bicycles, cars, buses, motor cycles, bullock carts or trucks etc. There are many means of transport in the world. You must have observed that most of all vehicles have wheels, which make them move. Wheel is a very important component of an automobile. The wheels not only support the weight of the vehicle, but also protect it from the road shocks. A wheel consists mainly of tyre, tube, hub and rim etc. You also know that a tyre is mounted on the wheel rim. It has to carry the vehicle load and provide a cushioning effect.

In this Unit, you will develop an understanding of the maintenance of tyres and tube used in a vehicle, so that its efficiency increases.

Session - 1 : Tyre and Tube Maintenance

Relevant Knowledge

Tyre

As you know that a 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 road shocks. You also know that a tyre is mounted on the wheel rim. It has to carry the vehicle load and provide a cushioning effect

Types of Tyres

The tyres may be of the following types:

1. **Tube tyre:** Tube tyre is traditional tyre. It encloses a tube in which air is forced to a high pressure as a cushioning medium. The outer position of the tyre which rolls on the road is made of synthetic rubber and is ` called tread. At the inner edges, beads are formed by reinforcing with steel wires. The beads act as strong shoulders, for bearing against the wheel rim. Rayon cords are formed into a number of piles. Where the beads and cords give strength to the tyre, the

threads provide resistance against slipping and thicker surface at the outer periphery.

2. **Tubeless Tyre:** Tubeless tyre does not enclose the tube. The air under pressure is filled in the tyre itself. The inner construction of this tyre is almost the same as that of the tube tyre. A non-return valve is fitted to the rim through which the air is forced inside the tyre.

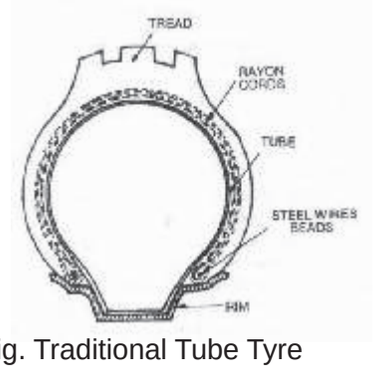

Fig. Traditional Tube Tyre

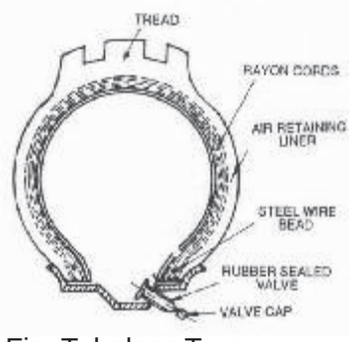

Fig. Tubeless Tyre

Advantages of Tubeless Tyre

- The tubeless tyres are lighter and run cooler than tubed tyre.
- The main advantage of a tubeless tyre is that it retains air for a long period even after being punctured by nail, provided the nail remains in the tyre. But the tube tyre releases the air almost immediately after being punctured.
- Any hole in the tubeless tyre can be repaired simply by rubber plugging.
- Ordinary punctures can be repaired with removing the tyre from the wheel.
- It can be retreated in the same manner as the tube tyre.

The tubeless and tube tyres are called pneumatic tyres, in which the air is forced inside the tube itself or in a tube which is fitted in the tyre. In both the cases, air is a cushioning medium. But in solid tube, it is not so. Neither the air is forced inside the tyre nor the tube is enclosed inside it. The tyre is completely solid and is mounted on the wheel rim. It is fitted on the wheels rim; it runs for a life long time. Because, it is a heavy tyre and there is no chance of being punctured. Once it is heavy and does not provide cushioning effect, it is not used on automobiles. Its use is limited to children's tricycles.

Maintenance of tyres and tubes

- Maintenance of tyres and tubes is an important part of the service of a vehicle.
- Maintenance gives a cushioning effect and stability to the wheel, Following steps are to be followed;
  - Clean the tyre regularly with water.
  - Check for uneven tyre wear
  - Check damaged uneven thread
  - Check air pressure of tyres at regular intervals
- Remove small chips of stone trapped in tyre treads with help of noseplier.
- Pressure of tyre should be maintained at the specified pressure given by manufacturer.
- Air pressure should be measured by using pressure gauge. Hold the pressure gauge on tube valve and press it gently, indicator will show air pressure of tube. If it is low, fill the air with the help of air compressor, again check the pressure, and repeat it in all four wheels and the spare wheel.

Rotation of tyres

For normal wear of tyre uniformly, it is recommend that all four wheels should be shifted crosswise after every 10000 kms run of vehicle or as per specification.

Session 1: Tyres and tubes maintenance

Exercise: Assignment

1. List of type of tyres with recommended air pressure

Sr. No.	Name of Component	Front tyre pressure	Rear tyre pressure

2. Prepare a poster showing changing of wheels crosswise

Session - 1 : Tyre and Tubes Maintenance
(Use additional sheets of paper if necessary)

Fill in the blanks

1) Pressure of is _____ kg/cm2
2) The tyre is _____on the wheel rim.
3) The tubeless and tube tyres are called _____ tyres.
4) Nose pliers is used to _____ small objects
5) _____ is used for loosening parts.

Session - 1 : Tyre and Tubes Maintenance
Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for tyres and tubes maintenance.

Part A

Share importance of maintenance of wheels and tyres used in a vehicle.

Part B

Discussed in class the following:

- Importance of air pressure in tyres.
- What are the advantages of rotation of wheels?
- Differentiate between tyres and tubes?
- Advantage of tubeless tyres.

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of maintenance.		
Able to identify different type of tyres		

Session - 2 : Repairing of Punctured Tube

Relevant Knowledge

Whenever air in the tube is released, it causes flat a tyre and the vehicle is not able to move. This may occur due to following reasons :

- Damage to the tube by means of sharp obstacles such as alpin, nail, tone etc.
- Due to faulty tube valve
- Rusted wheel rim
- Driving at low air pressure leads damage to the tube

Fig: Puncture Tube

Repairing of Punctured Tube

- Steps to remove the puncture from a tyre wheel;
- Loosen the wheel nuts
- Raise the portion of punctured wheel by placing the jack at lift point strictly
- Remove the punctured wheel from hub
- Keep the removed nuts safely with washer
- By using tube valve, release the remaining air from the tube
- Place the blunt lever to remove the tyre bed from the wheel or place the wheel on the tyre removing machine.
- Take out the tube gently by supporting the tube valve.
- Inspect the inner portion of tyre and check for pointed items, remove with the help of nose plier.
- Fit the valve back in the tube and fill the air. Check for leakage by placing the tube in water container.

- Mark the punctured area from where air is coming out.
- Place a tooth pick/matchbox stick in puncture hole

We can repair punctured tube with two processes given below;

Cold Patch Process

- Dry off the puncture tube
- Rub the punctured place with fine grade emery pape/rasp/rubber file
- Apply the cold patch adhesive solvent on and around the puncture area and allow it to dry for few minutes.
- Take out the cover from the cold parch and place centrally on the punctured portion of the tube in mini press unit and press the cold patch
- After repairing the puncture, again fill the air and check for leakage.
- Before fitting back tube in tyre, apply white powder (French chalk powder) inside the tyre.
- Fit tyre bed on wheel rim and seethat this is fitted properly other wise use the tyre removing machine
- Fix wheel back on the hub.
- Diagonally tighten the nut with specified torque.
- Fill the air of recommended pressure
- Remove the jack by lowering it.

Fig: Adhesive Solvent

Hot Patch Method

- Hot patch method is carried out with the help of small, vulcanizing machine.
- After cleaning the punctured part with the help of emery paper / rasp file apply adhesive solvent (black in colour) on it.
- Cut a piece of rubber in round sharp from the roll specially available for hot patch and place it centrally over the puncture, and press it.
- Place the punctured portion downward on the heater plate and adjust the hand wheel of vulcanizer by rotating in clock wise direction so that the pressure plate just presses on the tube.
- Switch on the vulcanizer and leave it for 10 to 15 min. Depending on the type of tube.

- After a specified time is over, switch off the vulcanizer and remove the tube and cool the tube.
- Fill the air and again check the tube for air leakage if any.
- After repairing the puncture, again fill the air and check for leakage.
- Before fitting back tube in tyre, apply white powder (French chaulk powder) inside the tyre.
- Fit tyre bed on wheel rim and see that this is fitted properly other wise use tyre removing machine
- Fix wheel back on the hub.
- Diagonally tight the nut with specified torque.
- Fill the air of recommended pressure
- Remove the jack by lowering it.

Fig. : Vulcanizer

Repair of tubeless tyre

One of the advantages of tubeless tyre is that while repairing the puncture, the tyre need not be detached from the wheel rim :

Fig: Repairing Kit

Instruments & Materials required :

- Bod-kin
- Wire brush
- Cold patch adhesive solvent
- Rubber plugs of different diameter
- Knife

Procedure

- Locate the puncture by inflating tyre and immersing the tyre with wheel rim in a water tank and mark it.
- Take out the nail if any and judge the puncture size, as the rubber plug to be selected is according to the puncture size.
- Clean the puncture and its surrounding with the help of wire brush.
- Apply solvent with the help of bod-kin to the punctured hole

Fig: Tubeless tyre Repairing

- Select a correct size of rubber plug and attach it with the bod-kin.
- Dip the bod- kin along with rubber plug to the puncture with the help of bod-kin
- Slowly take out the bod-kin. The rubber plug will be in the puncture.
- Cut the rubber plug approximately 6 mm above the tyre trade.
- Fill the air in the tyre.
- Tyre is ready for use.

Session - 2 : Repairing of Punctured Tube
Exercise : Assignment

1. List the steps used in cold puncture repairing

Sr. No.	Steps used

2. Prepare a poster showing equipment used in puncture repairing

Session - 2 : Repairing of Punctured Tube
Answer the following questions
(Use additional sheets of paper if necessary)

Fill in the blanks

1) _____is used for cleaning the tyre
2) Trace the puncture tube must be placed in the _____
3) _____ machine is used hot patch process
4) Avoid friction between tube and tyre _____ is used
5) For removing nail from tyre _____ is used

Session - 2 : Repairing of Punctured Tube
Checklist for Assessment Activity

Use the following checklist to see if you've met all the requirements for repairing of punctured tube.

Part A

Share importance of puncture repairing

Part B

Discussed in class the following:

- Tubeless tire repairing in the class
- Write the difference between hot and cold process of puncture repairing.
- What are the steps to be followed in repair of placing hot patch

Performance standards/criteria covered by this assessment

Performance standards	Yes	No
Able to explain importance of puncture repairing		
Able to list general step of puncture reparing		

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	Rajput R K, Laxmi	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

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UNIT - 6

REGULAR MAINTENANCE OF BRAKES

Unit Description

This unit provides introductory knowledge & skills covering vehicle servicing, specially with regard to regular maintenance and adjustment of brakes system both hydraulic brakes and mechanical (Emergency Brake).
Students will be given a broad view of these important issues.

Resources Required

- Notebooks, Pen, Pencil, Eraser,
- Computer, Open Source Software for making digital presentation, LCD projector.
- Sketches, pictures, animation and videos of tube and tyres of automobiles and its components.
- Posters for building awareness about these topics.

Nominal hours: 25 Periods

Elements and Performance Criteria

- Elements define the critical learning outcomes of a unit of competency.
- Performance criteria specify the level of performance required to demonstrate the achievement of the Competency Element.

Element of Knowledge	Performance Criteria
Brakes and their maintenance	
Brake adjustment	

Relevant Knowledge and Skills

1. Relevant Knowledge

- Brakes and their maintenance
- Brake adjustment

2 Skills

Able to do/repalce above items in a vehicle

- Brake testing
- Brake maintenance
- Brake adjustment
- Brake shoes clearance

Assessment Plan

Session No.	Assessment Method	Due Date	Completion Date
1.	Fill in the Blanks		
2.	Fill in the Blanks		
3.	Fill in the Blanks		

Introduction

In this Unit, you will develop an understanding of the maintenance of brakes used in a vehicle, so that its efficiency increases.

Session-1 : Brakes and Maintenance

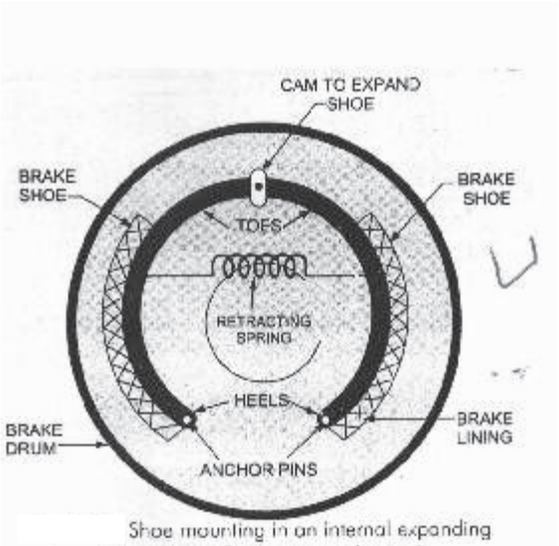
Relevant Knowledge

Brakes

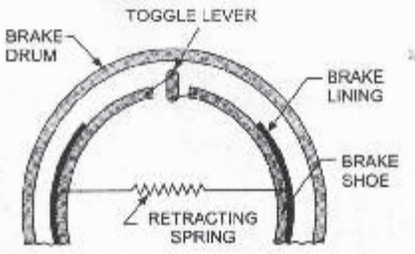
Vehicle is a fast moving means to transport occupants safely from one place to another according to requirement. Speed of vehicle depends upon traffic and road conditions. For the safety point of view it is necessary to control the driving of vehicle and the car from high speed to moderate speed and bring it to rest depending upon traffic and road conditions. For this a means is required to slow down or bring to rest is in shortest possible distance and minimum time interval. For this a system used in vehicle is brakes.

Vehicle is directly linked with life of passengers and goods.

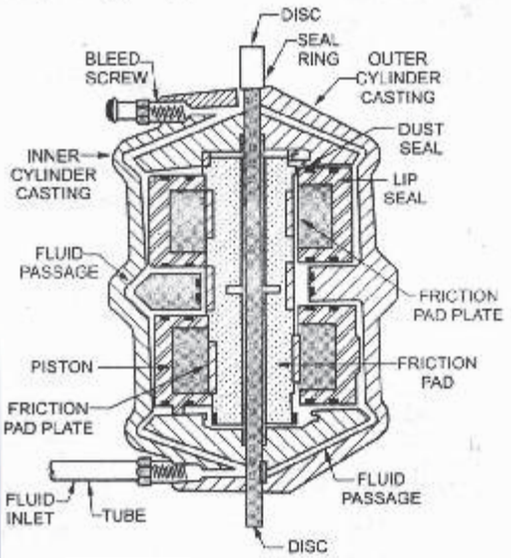
Life and comforts are not only required for passengers luggage and drivers but also other road user (traffic). Manufacturer provide such a brake so that it should be effective, safe in operation and easily adjustable. Its characteristics should be quite good. It must be enough strong so that vehicle should be stopped effectively. It should be such that avoid skidding and should be in complete control of driver so that it should be most effective at the time of emergency.



Shoe mounting in an internal expanding brake (using Cam to expand shoes)



Toggle lever is used to expand shoes.

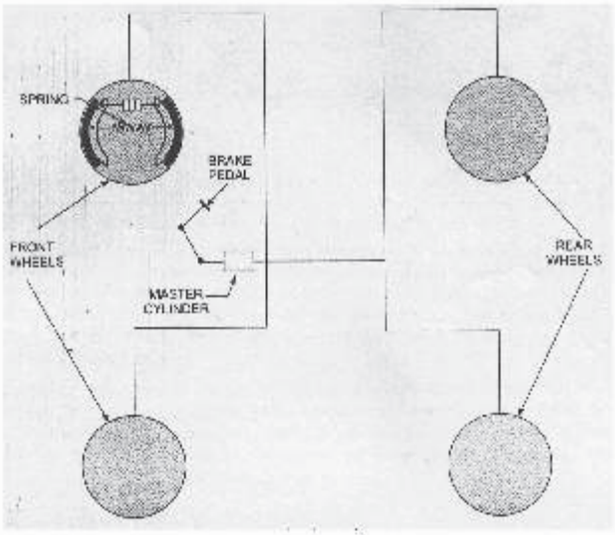


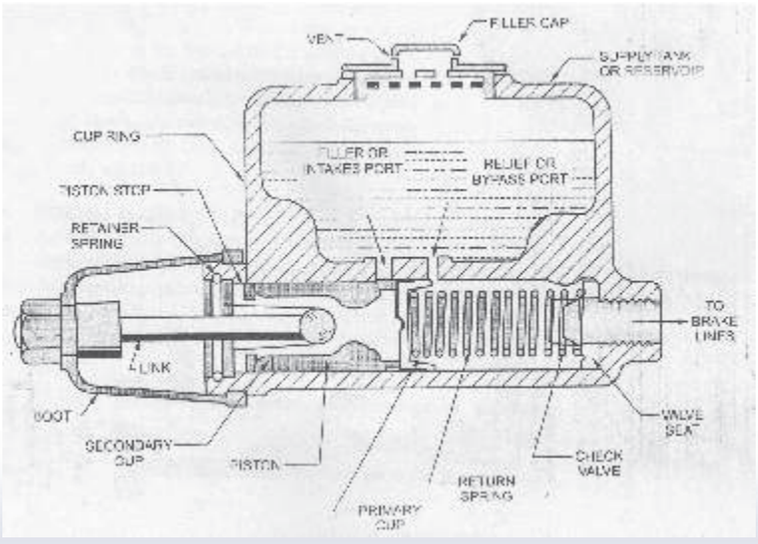
Caliper type disc brake.

Principle of braking

Principle of braking is like this during accelerating of the vehicle heat energy of the fuel is converted into power in term of kinetic energy of the vehicle.

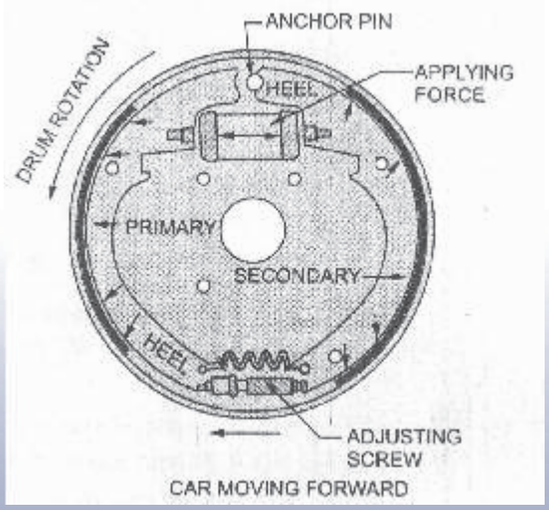
During braking this kinetic energy of the vehicle is converted into heat energy by means of friction produced between two sunfaces, brake drum and brake shoes. Tractive effort is produced at the peripheries of driving wheel. Where as opposite braking torque is produced at all the wheels peripheries by friction force.





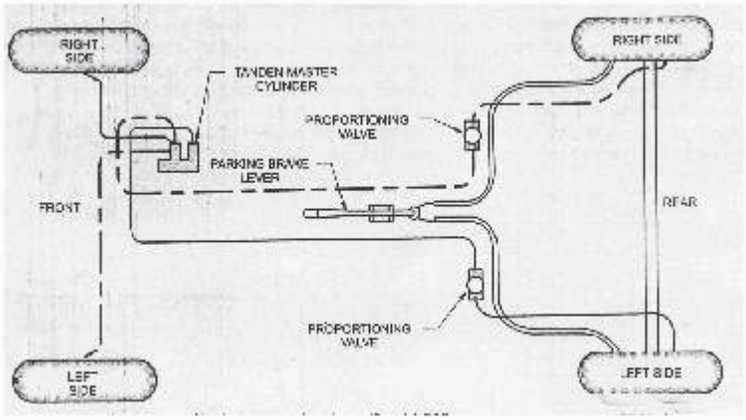
Performance

To get best possible performance of brake it is very essential to know in and out in detail about it.



Mainly brake system are two types:

1) Main brake (service brake).
2) Parking brake (emergency brake).

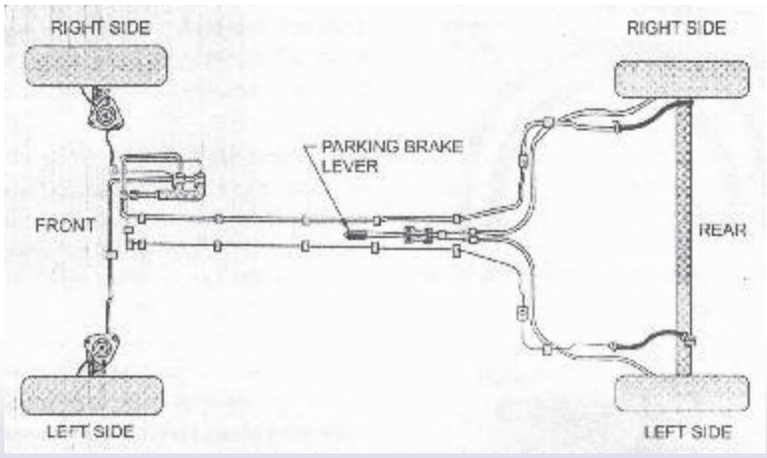


Main or service brake is usually actuated and operated by foot where as parking or emergency brake by hand.

With respect to the method of braking and acuation of brake shoes on revolving brake drum, it is of two types:

a) Internal Expanding Brakes
b) External Contacting Brakes

Power applied by driver on brake paddle to stop the vehicle is limited so it is realized to increase the braking force to stop the vehicle within minimum stopping distance to save the life of other traffic or road user.



For this power brake or power booster brake is used.
Hydraulic brake is most effective and efficient for the vehicle. So it is used as main brake or service brake. In modern age most of the vehicle is equipped with this brake hydraulic power booster is also used in this brake.

Hydraulic Brake work on Pascal's Law

If a specific characteristic liquid is kept in a closed vessel some pressure is applied on it is from one side it would be equally transmitted in all side without- diminishing. Due to this property, it is far better effective brake than mechanical.

For Heavy commercial vehicle, large braking forces are needed. Therefore, due to limited strength of driver large braking force requirement is fulfilled by boosting hydraulic pressure in the brake system. For this power assisted system is attached with hydraulic brakes.

Brake fluid

For transmitted the breaking force in hydraulic brake system specific characteristic fluid (liquid) is used.

It should have definite characterized fluid. It should be chemically inert at, high and low temperature with components of brake system.

High boiling point low freezing point, non viscous, incompressible. This liquid is compressed at master cylinder by the application of force applied by driver at brake paddle, is equally transmitted to all the four wheel cylinders.
It is very essential the brake liquid should be used to those which is recommended by the manufacturers.

Brakes pedal

If mechanical advantage of the system is high small force are required to apply on brake pedal which would produce large force against the brake shoes.
Large mechanical advantage system results in little movement of wheel cylinder pistons and shoes. To get rapid braking action brake shoes are attached very close to the drum. When the brakes are applied shoes will have to move slight to make forceful contact with brake drum.

Self Equalization

Mechanical brake system equal braking action obtaining at all four wheels are difficult. In this brake system better lining or closer adjustments would stop earlier when brakes are applied. Varying length of roads would cause un even braking action.
In case of hydraulic brake system all brake shoes are forced with drums by initial build up Pressure by applying pressure on brake paddle. Pressure in entire system increases sufficiently to produce braking action. Thus all the wheel brakes are forced to act together with equal pressure and equal force of action.

In hydraulic wheel brakes internal expanding type wheel brakes are provided on all the four wheels for braking action.

Brake shoes are secured to stationary backing plate on rear wheel attached to axle housing. Where as on front wheel to the steering knuckle.

Brake Drum

Brake drums are thin and cylindrical members. Outside ends are closed inside open so that brake shoes could be admitted to put.
In passenger car & brake drums are mode of cast iron, cast iron liner and steel alloy.

Chrome-nickel iron

Cast iron provide higher coefficient of friction steel provide strength.

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Self Energizing Brakes

In most of the model vehicle hydraulic wheel brakes of drum type is self energizing or we can say servo feature type which is utilized increase like braking pressure.

Hydraulic Brake Master Cylinder

In some vehicle master cylinder is rigidly fastened to the car frame by means of pedal rod to service brake foot pedal brake lines connect its outlet to wheel cylinder.

Master cylinder bolted to engine side. It consists of single casting that contains both the supply tank or reservoir and master cylinder spool shaped piston is connected to pedal link so that when brake pedals is depressed the piston moves towards the brake line to force brake fluid into the lines, here check valve is attached.

The supply tank (reservoir) supplies liquid to the system through two parts.

Larger one (inlet part) is connected to the hollow portion of piston between primary and secondary cups which act as piston seal.
Smaller relief by pass or compensating post connect & reservoir directly with cylinder line.

When foot pedal is at off position liquid may flow from reservoir through relief part to master cylinder supply lines.

When the brake pedal is depressed master cylinder piston move forward to force liquid under pressure into the system.

When brake pedal is released return spring quickly force the piston back against the piston.

A specified amount of play is provided in the pedal to piston linkage to ensure the complete return of the piston to its stop position to avoid the possibility of blocking the relief part in release position.

Over Hauling / Maintenance of Brake System

The safety and security of the vehicle, passengers and goods depend upon the efficient braking action of the brake system.

For this its regular maintenance is essential so that it would work efficiently.

Wrong adjustment, worn out brake drum. Brake shoes, oil on their lines, leakage of brake oil old or ruptured leak proof may cause failure of make system.

Before carrying only any repair work it is essential to inspect the some important parts condition and try to know their working condition.

First of all we should check the brake line. If there is leakage of any oil seal part we should replace them with new one.

Both type of brakes, Hydraulic and mechanical should be checked properly.

We should check the brake shoes, whether its is en good working condition or not. If not it is not very good condition it should be replaced by new one. We should always replaced by whole new set both of primary and secondary side.

Braking force actuated are of two types
1) Drum type
2) Disc type

Disc type is suitable for bike, car, jeep or light and moderate light vehicle.

Disc brakes are used in most of the modern cars which has two friction pad held on either side of metal disc rotating with wheel. These brakes are usually self adjusting type yet after 800 km checked if damaged or worn out should be replaced

It is desirable to check brake oil level of master cylinder after travel of 1600 km.

Before refilling it is required to check its leakage system

After every 8000 km of travel of vehicle its brake shoes line should be checked, its thickness should be checked, caliber should be checked.

Generally overhauling of brake is done after movement of 4800 km fo the vehicle.

We should replace the return spring, wheel cylinder seal, brake shoes, line brake oil rubber, bleeding of brake. Brake fluid must be replaced after 3500 km of journey.

We should replace the retainer spring of wheel cylinder if its stiffness has lost. We should replace all those parts which are not in working condition and require to replace. We should specially check the leak proof system of wheel cylinder and master cylinder very carefully.

Session - 2 : Brake Adjustment

Relevant Informations

Brake system is such a device that it convert the kinetic energy of the vehicle into heat energy by means of brakes contact surface.

The braking power must be proportional to the weight and speed of the vehicle. This power depends upon the coefficient of friction between friction brake members, pressure force together, total area of contact surface, resistance of tyre to rolling on road.

Transfer of weight from rear wheel to front wheels should be done when brakes are applied on four wheel braking system

System must be so designed so that only a safe proportion of braking effort takes place on the front wheels otherwise front brakes may get locked and enter fare the steering system

Minor brake adjustments

In many cases all that is needed is a minor brake adjustment

1) For this brake shoes must be moved neared to the drum by means of an adjusting screw or can to obtain better braking.
2) It should be insure that all the brakes should hold equally. All four wheel must be set with equal drag.
3) When adjusting self energizing type brake, it is important to lighten the adjustment till drum is locked.
4) Adjustment of mechanical linkage for parking and emergency brake should be made when ever service brake is adjusted.

Major brake adjustment

1) A major brake adjustment involves removing the wheels and brake drum properly
2) Inspect the lining for wear and tear of drum for scores and becoming out of roundless.
3) If the lining are glazed, greasy, thin or worn lush with rivets they should be replaced.
4) During major adjustment inspection of hydraulic system mechanical brake linkage for parking and energenly brake is required.

5) If it is required belong of master cylinder and wheel cylinder repair should be done.
6) After that new position and rubber cups should be installed
7) Though it is better to install new master and wheel cylinder set than to repair.
8) Brake system should be completely cleaned throughly with denatured alcohol.
9) We should remove the alcohol properly from entire system.
10) Replace those parts which have worn out or lost their lives by new pieces.
11) Then reassemble the hydraulic systems parts linkage between brake pedal and master cylinder piston.
12) Provide the amount of brake pedal free play which is specified by the manufacturer.
13) Brake pedal free play assure a complete return of the position when brake is released.
14) Only those hydraulic brake oil should be used which is standerised by S.A.E. No. recommended by vehicle manufacturer.
15) Only that brake oil of S.A.E. No., be used which is prepared by a reliable manufacturer.
16) After setting bleeding of brake should be stone by proper manner if air bubble is formed in brake oil line
17) Some service person prefer to bleed the system by opening the bleeder valve while the system is under pressure.
18) The master cylinder must always be kept filled with brake oil white bleeding of brake is done.
19) Bleeding of brake line should always be done by keeping the brake drum in place otherwise pressure of liquid will push the piston out of wheel cylinder.
20) Bleeding of longest line should be done first.
21) Special equipments should be used to set hydraulic brake whole system.

Trouble shooting possible causes and remedies

A Brake Drag
(Remedies applied without pressing the pedal)

Causes	Remedies
1. In correct brake fluid which may corrode rubber part	1. Drain out the brake oil by bleeding the system with alcohol. Replace all rubber cups and hoses Feed with appropriate one

2. Clogged compensating part	2. Clear the port by best practice Replace the master cylinder by new one
3. Clogged line leading to master cylinder	3. Replace by new one
4. Brakes adjusted to light	4. Re-adjustment should be done of brake.
5. No pedal free play	5. Adjustment should be made with providing recommended free play specification

Car pull on side on application of brake

Causes	Remedies
1. Grease oil or brake fluid soaked lining	1. Clean the brake drum seek the source of grease oil, brake oil. Replace the lining
2. Loose wheel bearing	2. Tighten or replace by new one.
3. Low tyre pressure	3. Inflate tyre pressure up to correct level
4. Primary and secondary shoes reserved	4. Place shoes in correct passions
5. Loose packing place, spring V bolts.	5. It should be lighten
6. Poor brake adjustment	6. Adjust the brake including anchor pin adjustment
7. Faulty wheel cylinder	7. Replaced by new one
8. Unequal camber	8. Adjust the camber to correct valve on both the wheels

Mechanical brake adjustment

i) Relevant knowledge

ii) Free Play adjustment unit is provided in the mechanical brake linkage, name of the unit is turn buckle. Which has internal thread of both ends in one side it is left hand thread and in other side it is having right hand thread. Turn buckle is fitted with the linkage along with locking nut at both ends. The adjustment is carried out by turning the turn buckle in either direction as its requirement.

Brake shoes clearance : Brake shoes clearance to be adjustment with the help of adjustment units provided with the brake plate (back plate). Generally there are two adjustments provided one for leading shoe and another for trail in side which have hexagonal head for fixing the spanner while adjusting. There are two inspection hole each for leading and trailing shoe. The filler gauge can be inserted through the inspection hole between brake drum and brake she to measure the clearance between them.

Procedure of free play adjustment of four wheels

1) Park the vehicle on hard level ground and chock the wheels.
2) Check the free play of the car and check how much it is deviated from the manufacturer's specification.
3) Turn the turn buckle according to increase or decrease the free paddle play loosen the lock nuts of turn buckle. (Adjustment unit)
4) After adjustment check the free play.

Free play adjustment of two wheeler hand brake

The free play of two wheeler is adjusted with the help of two wheeler is adjustment with help of stretching the outer cable (sleeve) of the brake.

1) Loosen the lock nut of adjusting unit.
2) Un screw the outer cable to extend the length of the cable.
3) Tighten the lock nut.
4) Check the free play of hand lever which is 1/16”

Brake Shoes clearance and Free Play adjustment of foot brake of two wheeler

In motor cycle the mechanical brake linkage is directly mounted with the brake operating lever and locked by a nut.

Procedure :

1) First screw in the mounting nut on the brake linkage till the brake shoe touches with the drum and the wheel seized to rotate.
2) From that position, unscrew the mounting nut one complete rotation
3) Check the wheel whether it is rotating freely without any drag.
4) In thus case the free play of brake paddle is adjusted automatically once the clearance between the brake shoes and brake drum is maintained.

Hydraulic Brake

Over hauling of master cylinder

1) After removing the master cylinder form brake system it should be throughly cleaned.
2) With the help circlip plier remove the locking ring provided for locking the master cylinder piston.
3) Remove the retaining plate, master cylinder piston along with piston return spring primary cup secondary cup and bulb assembly.
4) After removing all the components clean properly in hydraulic fluid and inspect for their service ability.
5) If required replace the complete kit (Primary and secondary cup value, piston return spring)
6) While assembly all the parts ensure that they are smeared with the fresh brake fluid.
7) Replace the retaining plate and locking ring and dust cover.

Over hauling of Wheel cylinder

1) Remove the wheel cylinder from brake system and clean.
2) Remove the pistons (Two numbers) and rubber along with spring.
3) Inspect all the items after properly cleaning in the brake fluid.
4) If require replace wheel cylinder kit with new one (kit) wheel cylinder cup, piston return spring.

Bleeding Operation

When air is trapped into the hydraulic brake system, brake will be in effective.
The procedure of removing air from hydraulic brake system is called bleeding of hydraulic brake.

Bleeding of Hydraulic brake systems Materials and instruments required

1 Glass jar, fresh hydraulic fluid, flexible plastic pipe of ½ meter length which can be fixed to the bleeding nipple.
2 Double end set spanner of size 10mm dry cotton waste.

Important points

1 If the bleeding nipple is provided with the master cylinder that should be bled first before bleeding before proceeding to bleed other wheels.
2 The sequences of bleeding points for right hand drive vehicle is as follows.
   (a) Master Cylinder (if bleeding nipple provided)
   (b) Left rear wheel
   (c) Right rear wheel
   (d) Left front wheel
   (e) Right front wheel

(i.e, the farthest wheel from the master cylinder to be bled, after cylinder bleeding and nearest to be bled at last)

Procedure of bleeding

(i) Park the vehicle on hard level ground put the hand brake (parking brake) on
(ii) Start the engine and run it for some line to build up the air pressure if the hydraulic brake system is assisted by compressed air (air assisted hydraulic)
(iii) Let one person sit on the driver's seat to operate brake paddle and let other person carry out the bleeding operation of different points one by one according to the sequence of mentioned above.
(iv) Connect the flexible pipe of the bleeding nipple and other end of the pipe should be placed in glass jar to preserve the bled fluid while bleeding air from the system.
(v) Ask the person who is sitting on the driver's seat to pump the brakes paddle numbers of times till it becomes hard to press but the brakes paddle to be kept in

presses condition.

(vi) Loosen the bleeding screw and you will be find air bubbles coming out through bleeding nipple.

(vii) Number of times same procedure may be repeated till fresh flow of fluid at a pressure coming through the nipple.

(viii) During every repetition the bleeding nipple should be closed and opened when the signal comes from the driver that he pumped and pressed.

(ix) After every operation of bleeding check the level of brake fluid in the master cylinder.

(x) Run the vehicle and check the braking efficiency.

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	Rajput R K, Laxmi	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

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BUILDING SKILLS•BUILDING FUTURE•

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