SECOND P.U N.S.Q.F LEVEL-4

AUTOMOBILE SUBJECT

MID TERM PORTION.

UNIT -1 SERVICE MANUAL

Session=01.

UNIT-2 INSPECTION AND REPAIR OF FASTENERS

Session= 01 TO 05.

UNIT-3 MEASURING EQUIPMENT'S

Session=01 TO 04.

UNIT-4 SERVICEABILITY, REPLACEMENT OR REPAIR OF ENGINE COMPONENTS

Session= 01 TO 04.

UNIT -6 SUSPENSION SYSTEM

Session= 01TO 06.

N.S.Q.F LEVEL 4
AUTOMOBILE NOTES
UNIT 1 --- SERVICE MANUAL
SESSION 1 – READING OF SERVICE MANUAL

I. FILL IN THE BLANKS

1. Service manual are important for **maintaining originality** in performance
2. Service manual is used for **service technician**
3. Service manual is available with a **service center**/service advisor
4. Mechanic use **service manual** for any defect in a vehicle.
5. The manufacturers develop **service manual**.
6. The automobile today has many electrical electronic gadgets which operate only at specialized **voltages, amperage and resistance**
7. Service manual should be kept in **handy** place.
8. This helps technician to take appropriate decision to solve the problems the service manual also gives circuit diagram with **color code**
9. The technician must use the service manual regularity to check the serviceability of component this helps the technician to decide about **replacement of component**.

II. Answer the following question:

1. Why service manual is used?

ANS: Service manual used for,

*) The technician/mechanic must use the service manual regularity to check the serviceability of component. This helps technician to take appropriate decision to solve the problem.

2. Importance of maintenance.

ANS: Any product after purchasing of some year it requires maintenance to maintain originality of that product so that it is very imp to of maintenance. It is also the key to successful maintenance of any motor vehicles.

3. What are the content of vehicle service manual?

ANS: The content of vehicle service manual are.

- Index * Page number *Expanded view of assembly *Disassembly sequence
- Tolerances, gazes, sizes of components *Serviceability *Life span
- Decision for Repair or Replacement *Assembly procedure and Working test procedure

4. Who develops the service manual?

ANS: The service manufacturers develops service manual, which gives clear cut ideas of their product like material used specification service limit span life of component storage life

5. Importance of service manual.

ANS: Service manual helps mechanic to learn new development, new changes, technique to disassemble, assembly procedure, testing etc.

6. What are advantages of using service manual?

ANS: Advantage of service manual are:

- To learn new development, new changes, technique to disassemble, assembly procedure, testing.
- To maintain originality in performance of vehicle.
- The service manual helps to teach the technicians to work on the vehicle systematically to solve the problems as well as to provide service to maintain originality.
- This helps the technician to decide about replacement of component.

7. List the areas covered by service manual

- Expanded view of an unit/assembly
- Name of parts with part number
- The specification of each part and their tolerances in assembly
- Sequencing of disassembly and precaution
- Sequencing of assembly with tolerance, play adjustment etc.
- Testing procedures and workability
- Maintenance schedule
- Replacement limit of components
- Trouble shooting chart
- Use of special tools and their part number

UNIT 2

Fasteners:-

An automobile vehicle is an assembly of a large number of sub-assemblies and components. The assemblies such as engine-clutch-gearbox-differential-wheels-brakes etc.

Each of these assemblies is formed by joining many components. Some of the components can move with respect to each other, others are physically fixed together, with no relative motion possible.

The first type of connection is called a **Kinematic joint**, intended to allow some motion) and the second type is called a **Rigid joint**. Both types of joints are important in manufacturing a vehicle.

The process and methods used for joining depend on the type of joint, there are five most common methods of joining:

. Mechanical fasteners
· Screws
· Bolts
· Nuts and
· Rivets
. Welding
. Brazing
. Soldering
. Adhesive bonding

In this we will study about the fasteners used in automobiles.

Mechanical fasteners

Mechanically joins or affixes two or more objects together. A fastener can be a bolt or a screw. Varieties of fasteners are available in the market as shown in Fig-1 and can be selected according to need or requirement.

Automotive fasteners are the mechanical devices or components like bolts, nuts, screw, stud, rivets, shims, pin, tie rods etc. used for holding or connecting two or more objects together in a structure. Fasteners are widely used in number of industries such as aerospace, defense, automotive, petrochemical, marine and pharmaceutical sectors.

Automotive fasteners are made up of variety of metals such as stainless steel, iron, brass, aluminum, nickel etc.



Session 1: Automotive bolts/machine screws

I. FILL IN THE BLANKS

1. A fastener is a hardware **device** that mechanically joins or **affixes** two or more objects together.
2. Automotive fasteners are made up of variety of **metals.**
3. A bolt is an externally threaded **headed** fastener, which is used in conjunction with a **nut.**
4. External threads are on the **bolt** or screws and internal threads are on the **nut**
5. In the country we use ISO **metric** thread
6. Machine screws have machine **thread** for use with a nut or in a **tapped** hole.

II. ANSWER THE FOLLING QUESTIONS.

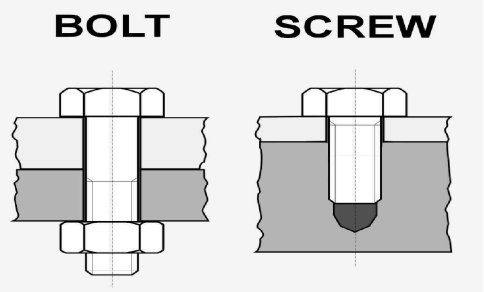
1. **Define bolts?**
   ANS Automotive Bolt is an externally threaded headed fastener, which is used in conjunction with a nut.

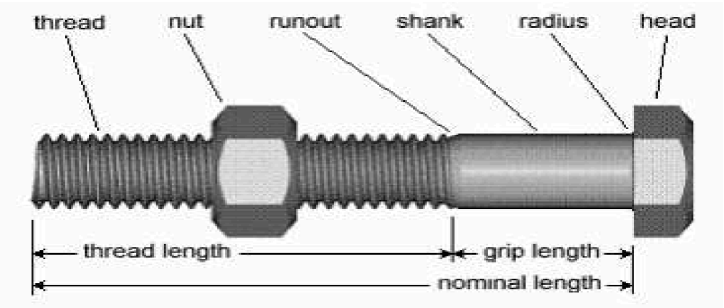
2. **Describe the importance of bolts.**
   ANS: Automotive Bolt is an externally threaded headed fastener, which is used in conjunction with a nut. It should always be tightened by holding the bolt head stationary and turning the nut.

3. **Describe the importance of machine screws.**
   ANS: The machine screw is an externally threaded headed fastener, which is tightened by applying torque to the head, causing it to be threaded into the material it will hold.

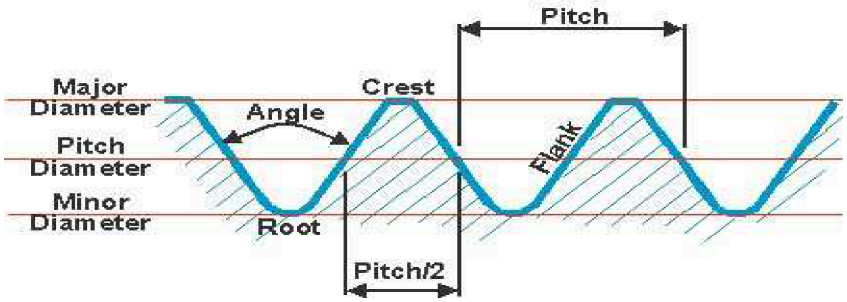
4. **What is importance of threads on bolt and machine screws and why threads are important?**
   ANS: A thread is a ridge of uniform section in the form of a helix on the internal or external surface of a cylinder. External threads are on the bolts or screws and internal threads are on the nuts.
   There are two types or directions of the thread helix, left hand and right hand threads. Most Common threads are right hand threads.

5. **Differentiate between bolt and screw.**
   Bolt: Automotive bolts often known as threaded fasteners is one of the types of auto fasteners that having a head at one end.
   Screw: The machine screw is an externally threaded headed fastener, which is tightened by applying torque to the head, Machine screws have machine threads for use with in a tapped hole.





6. What you understand by metric thread? Make a profile of metric thread and state all the terminologies.



Pitch diameter: The pitch diameter of a parallel thread is equal to half the nominal pitch of the thread.

Major diameter: The major diameter of a thread is the diameter of the imaginary co axial cylinder that just touches the crest of an external thread.

Minor diameter: The minor diameter is the diameter of an imaginary cylinder that just touches roots of an external thread.

Crest: The crest of a thread is the prominent part of a thread, whether internal or external.

Root: The root is the bottom of the groove between the two flanking surfaces of the thread whether internal or external.

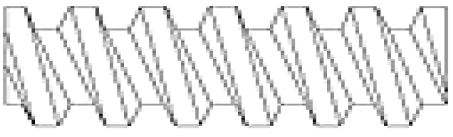
Flank: The flanks of a thread are the straight sides that connect the crest and the root.

Thread angle: The angle of a thread is the angle between the flanks, measured in an axial plane section.

Pitch: The pitch of a thread is the distance, measured parallel to its axis, between corresponding points on adjacent surfaces, in the same axial plane.

7. List the materials used for bolt and machine screw

Aluminum, Brass, Copper alloy, Plastic, Steel, Hardened steel, Stainless steel, super alloy and Titanium



Right Hand Thread



Left Hand Thread

Session 2 Automotive Nuts

I. Fill in the blanks:

1. A nut is a type of fastener with a **threaded** hole.
2. For joining two metal part the nut is screwed on the **bolt.**
3. The **pitch** of the bolt and nut must be same else the nut cannot be **screwed** on the bolt.
4. The nut can have left hand or right hand **internal** threads.
5. A hexagonal nut is a type of metal fastener that has **six** sides.



II. Answer the following questions:

1) What is nut?

ANS: A nut is a type of fasteners with a threaded hole. Nut are almost used opposite a mating bolt to fasten.

2) What are the material which used to make nuts?

ANS: Aluminium, brass, copper alloy, plastic, steel and stainless steel, super alloys titanium etc.

3) Describe the importance of nuts.

ANS: Automotive nuts, one of the important types of auto fasteners are usually square or hexagonal shaped metal having a threaded hole which is used for screwing a bolt that hold together.

4) Why the nuts are made of four or six faces?

ANS: Because the sides of 4 and 6 faces give enough faces for tool to grip and not to slip when applying higher torque.

5) What is importance of threads in a nut and why threads are important?

ANS: For joining two metal part the nut is screwed on the bolt. Therefore the thread profile of bolt and nut must match. The pitch of the bolt and nut must be same else the nut cannot be screwed on the bolt.

Because, thread in a nut given to grip and not to slip when applying higher torque.

6) Name different types of nuts used in automobile?

ANS: Automotive nuts can be of different types such as simple nuts, collar nuts, locking nuts, t-nuts, hex nuts, and jam nuts, lug nuts, plate nuts, self-locking nuts, stainless steel nuts Heavy hex, square, coupling, Flange, nylon insert lock, wing etc.

7) Differentiate between bolt and nut.

Bolt: Automotive Bolt is an externally threaded headed fastener, which is used in conjunction with a nut.

Nut: A nut is a type of fastener with a threaded hole. Nuts are almost always used opposite a mating bolt to fasten a stack of parts together.

8) What you understand by ISO metric thread?

ANS: All the dimensions are related to the internal diameter of the nut.

SESSION-3: AUTOMOTIVE STUDS

I. FILL IN THE BLANKS

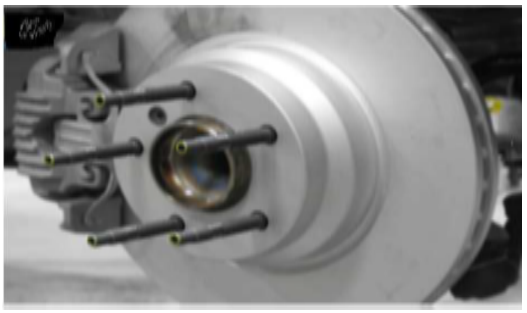
1. Studs are mechanical **fasteners** which are **threaded** on one or both ends.
2. Automotive studs are fastened at both the ends with the help of an unthreaded **shank**.
3. Wheel studs are the threaded fasteners that hold on the **wheel** of many automobiles.

4. Press-in studs are installed from the back side of the **disk** or **drum**.
5. For a performance or **heavy duty** application, the use of **stud** is preferred whenever possible instead of main cap bolts.

II. Answer the following questions:

1. What is stud?

ANS: Stud are mechanical fasteners which are threaded on both ends One end is secured to an object and the other end is with a nut,



2. List the types of studs used in a vehicle

- Engine Stud
- Wheel stud
- Stainless Steel stud



3. Describe the importance of studs.

- Studs are mechanical fasteners which are threaded on one or both ends. One end is secured to an object. The other end is used typically with a nut.
- Automotive studs are commonly referred to as a double ended automobile fastener.

4. What are the advantages of studs over bolts?

- Studs are requires a two part assembly operations.
- They eliminate deviations from perfect square ness in an assembly.

5. In what conditions the studs should be used in place of bolts?

- For performance of heavy duty applications
- The use of stud is preferred whenever possible instead of main cap bolts, in those instances where a choice is available.

6. Differentiate between bolt and stud.

- **Bolt:** Automotive Bolt is an externally threaded headed fastener, which is used in conjunction with a nut.
- **Studs:** Automotive studs are commonly referred to as a double ended automobile fastener.

7. Importance of wheel stud.

ANS: Wheel studs are the threaded fasteners that hold on the wheels of many automobiles. They are semi-permanently mounted directly to the vehicle hub, usually through the brake drum or brake disk.

SESSION- 4: AUTOMOTIVE WASHERS AND RIVETS

I. FILL IN THE LANKS

1. A washer is a thin **plate** with a hole that is normally used to **distribute** the load of threaded **fasteners.**
2. Automotive washers are the small flat **dishes** having a **hole** in the center.
3. Rivets are the oldest forms of automotive fasteners used in **building** traditional wooden boat.
4. Rivets are usually **categorized** on the basis of their heads.
5. Circlips are often used to **secure** pinned connections.
6. Split pins are typically made of **shaft** metal, making them easy to **install** and remove.
7. Spring pins have a body diameter which is larger than the hole diameter, and a **chamfer** on either one or both ends to facilitate **starting** the pin into the hole

II. Answer the following questions:

1. Describe the importance of washers.

ANS: A washer is a thin plate (typically disk-shaped) with a hole (typically in the middle) that is normally used to distribute the load of a threaded fastener, such as a screw or nut. Washers usually have an outer diameter (OD) about twice the width of their inner diameter (ID).

2. Describe the importance of rivets.

ANS: Rivets often regarded as a semi-permanent mechanical fastener having a cylindrical shaft with head on one hand and the end opposite the head is called buck-tail. Rivets are the oldest forms of automotive fasteners used in building traditional wooden boat. But now rivets are used as automobile fasteners in a wide number of applications like vehicle bodies, aircraft, bridges, cranes, building frames etc.

3. What are the advantages of using washers as fasteners?

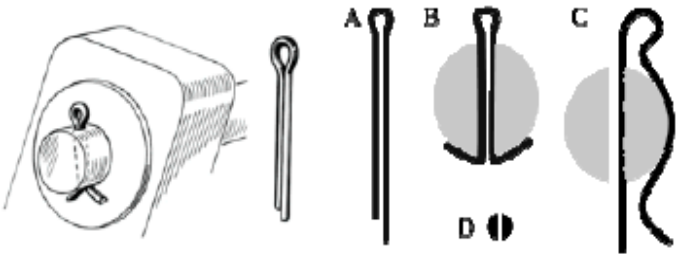
- To protect the surface from damage during installation.
- They distribute the pressure
- Prevent the fasteners from moving.

4. In what conditions the rivets should be used as fasteners?

ANS: Because there is effectively a head on each end of an installed rivet, it can support tension loads however, it is much more capable of supporting shear loads.

5. What are the advantages of using split pin as fastener?

- A split pin washers used to reduce friction between the split pin and the wheel.
- Split pin are strong but after they can wear and break

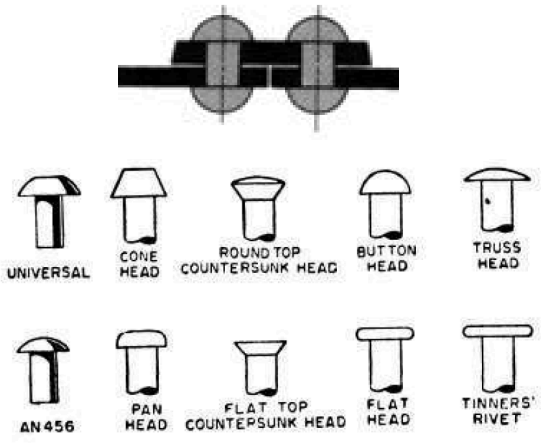


6. What are the advantages of using spring pin as fastener?

- The benefits of spring pin washer lies in the trapezoidal shape of the washer.
- This prevents loosening.

7. Name different types of rivets.

- Universal
- Cone Head
- Round top countersunk head
- Button Head
- Truss Head
- Pan Head
- Flat Head
- Flat top countersunk head



8. What are uses of circlip?

- Circlips are commonly used in motors, turbines and pistons.
- Circlips fit into grooves on the inside of a bore or outside of a shaft.
- Circlips are often used to secure pinned connections.

9. **Name different types of washers.**
   *Fender, split lock, dock, sealing, finishing etc.

10. Name different types of rivets.
Types of rivets are: 1 universal, button head, pan head, cone head, and trues head

SESSION- 5: REMOVAL OF DAMAGED FASTENERS AND REPLACEMENT

I. FILL IN THE BLANKS

1. In automobile, due to **jerk,** vibration and **corrosion** screws get broken.
2. Use hacksaw **blade** and dress the **groove**.
3. In automobile, due to **jerk** movement and vibration, nuts and bolt get **loosened**.
4. A stud is stronger than a **bolt,** with correct stud installation; the stud is screwed into the **threaded** hole without applying pressure.
5. Anti-rust solution are used for dissolving the **dust**, rust from the **fastener** area.

II. Answer the following questions:

1. Method to remove screw with spoiled head.

- Use hacksaw blade and dress the groove
- Now use screw driver of thick snap and turn anticlockwise
- This removes the screw, if it is not responded
- Take a prick punch and hammer. Give light blow in anti-clock wise direction.
- If it does not work then use drill machine of drill bit smaller than size of screw
- Now drill it at the center of screw, now 100% screw will be removed

2. Method to remove screw without head/un headed.

- If the screw is broken at the top of the assembly
- Remove the other screw and separate the assembly
- Hold the jaws of the crippler on broken screw
- Lock the crippler and turn anti-clock wise & Screw may come out

3. Method for removal of UN headed screw broken in the assembly.

- Use drill machine of drill bit smaller than size of screw
- Now drill it at the center of screw, now 100% screw will be removed
- Now dress the threads before fixing new screw

4. Method of removal of spoiled headed nut/bolts.

- Use spanner of smaller size, fix it on the nut/bolt and turn anti-clock wise It will come out
- If it does not come out, use prick punch.
- Take a prick punch and hammer at the face of nut/bolt. Give light blow in anti-clock wise direction.
- If it does not work then use drill machine of drill bit smaller than size of nut/bolt
- Now drill it at the center of nut/bolt an remove the edges of nut, in case of bolt remove the bolt head by using crippler, remove the remaining part of the bolt from the assembly.

5. **Method of removal of broken/ spoiled threaded studs.**
   - To remove spoiled threaded stud, give gentle pressure on assembly by using screw driver, this will lift the spoiled portion of the stud threads upward.
   - Turn the nut in anticlockwise, turn the stud assembly and gentle press the screw
   - driver inside so that stud will come out
   - In case, if the nut threads internal threads of the nut/external threads of the studs are spoiled, then give welding spot to nut and stud

6. **Importance of antirust solution.**

   ANS: Anti-rust solution are used for dissolving the dust, rust from the fastener area. Use of this solution will make fasteners comfortable during removal/changing process. Now days Indian as well as imported antirust solution/spray are available in the market.

Use of anti-rust solution

Anti-rust solution are used for dissolving the dust, rust from the fastener area. Use of this solution will make fasteners comfortable during removal/changing process. Now days Indian as well as imported antirust solution/spray are available in the market.

UNIT 3 - MEASURING INSTRUMENT

SESSION 1 – HANDLING AND USAGE OF DIRECT AND INDIRECT MEASURING INSTRUMENTS

I. FILL IN THE BLANKS.

1. A **measurement** is assigning a value to length, mass and time.
2. The measuring instruments, which do not require the help of other **instrument** for measuring are called **direct** measuring instruments.
3. Steel scale/rule is a **line** measuring device.
4. The Vernier Caliper is a **precision** instrument that can be used to measure **internal** and external distances extremely accurately.

5. In the Vernier caliper sliding jaw containing the **Vernier** scale, moves over the main scale.
6. For measuring the depth of **hole**, recesses and **distance** from a plane surface to a projection, the Vernier depth gauge is employed.
7. The micrometer is a precision measuring instrument, used by engineers and technicians for **inspection** and measuring the distance between two **faces.**
8. The digital micrometer displays the **final** reading.

II. ANSWER THE FOLLOWING:

- **What is measuring equipment?**

ANS: Measuring equipment are measuring tools they are to measure dimension of an object
Ex: calliper, micro meter, gauges etc.

- **Classify the measuring instruments?**

ANS: Measuring instruments are classified in automobile field as follows:

1) Liner measurements
2) Direct measuring instrument ex: steel scale screw gage.
3) Indirect measuring instrument ex: callipers inside and outside.
4) Angular measuring
5) Plane surface measurement

1. **Make a list of direct and indirect measuring instruments**

ANS: Direct measuring instruments: Ex: steel scale screw gage
In-Direct measuring instruments: Ex: callipers inside and outside

2. **Importance of measuring instruments.**

ANS: Important measuring instrument used in our daily life. Similarly measuring instruments are also used in automobile serviceability. These instruments help in measurement of important dimensions of components.

Important measuring instruments used are Dial gauge, Bore Gauge, Vernier caliper, Depth Gauge, Micrometer, Hydrometer and Multi meter etc.

3. **What is difference between direct and indirect measuring instruments?**

Direct Measuring Instrument: The measuring instruments, which do not require the help of other instruments for measuring, are called direct measuring instruments. Usually a line measurement using scale Ex: scale steel tape calliper etc.

In Direct Measuring Instrument: Indirect measuring instruments are measuring instruments, they are used to measure the dimension of an object indirectly,

Ex: callipers, inside calliper, outside calliper

4. **Describe the procedure for determining the least count of Vernier caliper.**

The Vernier scale consists of a main scale graduated in centimeters and millimeters (in inches if there is imperial scale).

Least count = one main scale (MS) division - one vernier scale (VS) division.\

Suppose 10 division of Vernier scale = 9 division of main scale. Therefore one division of Vernier scale = 9/10 = 0.9 mm of main scale division (one division of main scale = 1 mm).

Therefore the least count will be

= 1 mm - 0.9 mm

= 0.1 mm or = 0.01 cm

5. **Describe the procedure for determining the least count of micrometer.**

Least Count (L. C) = Pitch/No. of divisions on micrometer barrel (thimble) where, Pitch = distance travelled by thimble on linear scale in one rotation, which is usually 0.5 mm unless stated. In the examples below, the number of division on the barrel are 50. Therefore the least count of the micrometer will be 0.5/50 = 0.01

Read the scale on the sleeve.

6. Describe the process for measurement with indirect measuring instruments.

There are situations where direct measuring instruments cannot be used. The simple calipers can be used in these situations. For measuring, the object is held between the ends, object removed and the ends are placed on steel scale to determine the distance. These calipers can be used to measure the length, outside and inside diameters.

7. Differentiate between Vernier and digital caliper.

Vernier Caliper: The meter scale enables us to measure the length to the nearest millimeter only. Automobile technicians need to measure much smaller distances accurately

Digital Caliper: it is refinement or replacement of the analog dial with an electronic digital display on which the reading is displayed as a single value.

8. Describe the parameters which can be measured with Vernier depth gauge.

- For measuring the depth of holes, recesses and distances from a plane surface to a projection.

- **Write a short note on the following**

***vernier calliper:**

Vernier calliper is a measuring tool commonly used to measure smaller distance an accurately.
*in vernier calliper can measure length diameter inside and outside diameter of an object
*the vernier calliper consist of a main scale and a fixed jaw and a movable jaw

- **Draw a neat diagram of vernier calliper**

SESSION 2 – ANGULAR MEASURING INSTRUMENTS

I. FILL IN THE BLANKS

1. Instruments used for measuring the angle are called **angular** measuring instruments.
2. A protractor is a device for measuring the angle between two **intersecting** lines.
3. The blade protractor has double graduations from 0 - 180° in opposite directions permitting the direct reading of angles and **supplementary** angles.
4. A bevel gauge is an **adjustable** gauge for setting and **transferring** angles.
5. The universal bevel protractor is designed for **precision** measuring and **layout** of angles.

II. ANSWER THE FOLLOWING:

1. **Make a list of angular measuring instruments**
   - Protractor
   - Blade Protractor
   - Bevel or Combination
   - Universal Protractor

2. **Importance of angular measurement and measuring instruments.**
   ANS: Instruments used for measuring the angle are called angular measuring instruments.

3. **What is difference between protractor and blade protractor?**
   Protractor: A protractor is a device for measuring the angle between two intersecting lines.
   Blade Protractor: This is a highly useful and accurate tool for setting bevels, transferring angles, small squaring tasks, and many other applications.

4. **Describe the procedure for using the bevel gauge/combination gauge.**
   - A bevel gauge is an adjustable gauge for setting and transferring angles. The handle is usually made of wood or plastic or steel and is connected to a metal blade with a thumb screw, the blade pivots and can be locked at any angle b loosening or tightening the thumb screw.
   - Gauge is mainly used to measure of angle of valve face. The straight edge is used to check the cylinder head, cylinder block

5. **Importance of universal bevel protractor.**
   - The universal bevel protractor picks up where the blade protractor leaves off. The universal bevel protractor is designed for precision measuring and layout of angles.
   - The universal bevel protractor is capable of measuring obtuse angles as well as acute angles

SESSION 3 – DIAL INDICATOR/GAUGE AND OTHER GAUGES

I. FILL IN THE BLANKS

1. Dial gauge is used as a measuring device to measure the accuracies in **alignment, eccentricity** of the parts/components.
2. Dial gauge works on the **rack** and **pinion** principal.
3. A telescoping gauge is a measuring tool with spring-loaded plunger used together with a micrometer to measure the inside of holes or bores.
4. A Vernier bore gauge measures a bore **directly**.
5. A dial bore gauge is a special tool, which is used to accurately measure the inside diameter of a hole, cylinder or pipe and will also detect **ovality** and tapers in bores.
6. Screw pitch gauges are used to check the **pitch** of the thread immediately.
7. Feeler gauges are used for checking the clearance between **mating** surfaces

II. ANSWER THE FOLLOWING:

1. **Various types of gauges are used for checking components of automobile. Make a list of these gauges**
   - Dial gauge, Digital Dial Gauge, Telescopic gauge, Bore Gauge, Screw Pitch gauge, Feeler Gauge

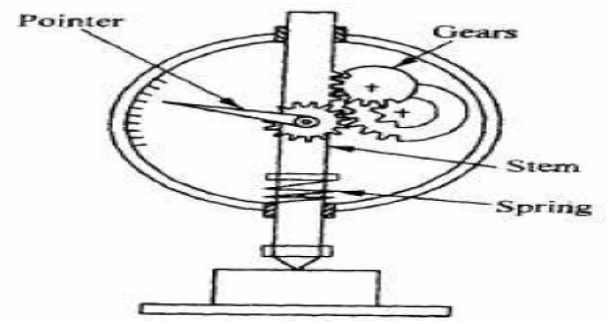
2. **Importance of dial indicator/gauge and other gauges.**

- It is used as a measuring device to measure the accuracies in alignment, eccentricity of the parts/components.
- Dial indicators are also great for checking crankshaft run out, crank end play, shaft thrust, and gear backlash, flywheel face run out,
- A dial gauge is like a fine watch. It consists of a graduated dial, pointer, plunger and a clamp.
- It measures the displacement of its plunger on a circular dial by means of rotating pointer**.**

3. Describe the working principle of dial gauge.

It works on the rack and pinion principle. A dial gauge is like a fine watch. It consists of a graduated dial, pointer, plunger and a clamp. It measures the displacement of its plunger on a circular dial by means of a rotating

Pointer.



4. Describe feeler gauge and its application.

- Feeler gauges are used for checking the clearance between mating surfaces.
- They are mainly used in adjusting the valve clearance and setting of spark plug gaps in automobiles.
- They are made from 0.03to 1.0mm thick of 100mm long leaves. The blades are pivoted in a holder.



. How to check clearance / gap using Feeler Gauge

To know or adjust the clearance/ gap, the **leaf** of the feeler gauge is **selected** and inserted in the gap, the leaf should not be loose or inserted with force. The leaf should go in the gap with slight drag/resistance. The value of the clearance/gap is read from the leaf of feeler gauge.

5. Importance of telescopic gauge

- A telescoping gauge is a measuring tool with spring-loaded plungers used together with a micrometer to measure the inside of holes or bores.
- Telescopic gauge is used to find out the internal diameter of pipe, cylinder bore and slots.
- This gauge has ratchet locking at top, handle, body and telescopic operated plungers
  - A telescoping gauge is an indirect measuring device,

6. Importance of Bore gauge.

- A dial or Vernier bore gauge measures a bore directly. The gauge has three symmetrical anvils that protrude from the gauge body that are connected to the dial or micrometer mechanism.

7. Importance of dial bore gauge

- A dial bore gauge (Fig-21) is a special tool, which is used to accurately measure the inside diameter of a hole, cylinder or pipe and will also detect ovality and tapers in bores.
- Dial-bore gauges are useful in checking for taper or out-of-round conditions in a cylinder bore as well as many other inside machinists measurements. In conjunction with a micrometer, a bore gauge will give the exact reading of a bore size.

8. Describe screw pitch gauge and its application.

- Screw pitch gauges are used to check the pitch of the thread immediately. It is very much in everyday tool used to pick out a required screw.

SESSION 4 – INSTRUMENTS ON THE DASH BOARD OF A VEHICLE

I. FILL IN THE BLANKS

1. The speedometer tells the driver the **speed** of a vehicle.
2. Tachometer tells how fast engine is turning in **revolution per minute** (rpm).
3. An odometer is an instrument that indicates **distance** traveled by a vehicle.
4. The fuel gauge informs abut status of the **amount** of fuel in the tank of vehicle.
5. The temperature gauge doesn't actually measure the temperature of your engine; instead, it measures the temperature of engine's **coolant.**
6. An automotive navigation system is a **satellite** system designed for use in automobiles.

II. ANSWER THE FOLLOWING:

1. List the important instruments which are fitted on a dashboard of a vehicle.

- Speedometer,
- Tachometer,
- Odometer and
- Fuel gauge, and
- Indicators such as gearshift position,
- Seat belt warning light,
- Parking-brake-engagement warning light and an
- Engine-malfunction light.
- Low fuel, low oil pressure,
- Low tire pressure and
- Faults in the airbag (srs) system.
- Heating and ventilation controls and vents,
- Lighting controls,
- Audio equipment and
- Automotive navigation systems

2. Importance of instruments on the dash board.

- A dashboard can be considered as a control panel placed in front of the driver on which he keeps an eye for proper functioning of the vehicle.
- The dashboard has cluster of instruments and gauges which convey the health of vehicle to the driver.

3. What information is given by the speedometer?

The speedometer tells the driver the speed of a vehicle whether he is driving fast or slow or within specified speed limit. Speed is measured in kilometers per hour.

4. What information is given by the odometer?

An odometer is an instrument that indicates distance traveled by a vehicle. The device may be electronic, mechanical, or a combination of the both. The device is helpful to know the distance covered between two destinations.

5. What information is given by the Tachometer?

Tachometer tells how fast engine is turning in revolutions per minute (rpm). Driver should avoid running engine so hard like “danger zone” as indicated on the tachometer.

6. What information is given by the fuel gauge?

The fuel gauge informs about the amount of fuel in the tank of vehicle. If you don’t keep an eye on your fuel gauge, you could run out of fuel. We should regularly check the fuel gauge so that we are not stranded at road due to absence of fuel.

7. What information is given by the temperature gauge?

- The temperature gauge doesn’t actually measure the temperature of your engine. Instead, it measures the temperature of engine’s coolant.
- It’s important to get an idea of how hot car typically runs.

8. What information is given by the malfunction indicator lamp?

- A malfunction indicator lamp (MIL), also known as a check engine light, is a tell-tale to indicate malfunction of a computerized engine management system.
- It is found on the instrument panel of most automobiles. When illuminated, it is typically either an amber or red color.
- The malfunction indicator lamp usually bears the legend CHECK ENGINE, SERVICE ENGINE SOON.

9. What is the use of navigation system in automotive vehicles?

- An automotive navigation system is a satellite navigation system designed for use in automobiles.
- It typically uses a GPS navigation device to acquire position data to locate the user on a road in the unit's map database.
- Using the road database, the unit can give directions to other locations along roads also in its database.
- Various companies manufacture this unit and same can be fitted in dashboard of vehicle.

10. What is the use of driver information system?

Now days most of the vehicles are fitted with DIS System. This system enables driver about various information such as spontaneous fuel consumption, range of travel, available quantity of fuel in terms of kilometer, digital watch with atmospheric temperature.

UNIT 4 - SERVICEABILITY, REPLACEMENT OR REPAIR OF ENGINE COMPONENTS

SESSION 1: RECONDITIONING OF VALVE MECHANISM

I. FILL IN THE BLANKS

1. A poppet valve is a **valve** typically used to control the timing and **quantity** of gas or vapor flow into an engine.
2. In overhead valve mechanism (OHV) the camshaft is fixed in the **crank case**.
3. In overhead cam mechanism (OHC) the camshaft is fixed in the **cylinder head**.
4. To overcome leakages of combustion gases, valve **reconditioning** is required.
5. Remove the valves using a valve **spring compressor**, observe the valve leakage.
6. Measure the **angle** of valve seat with help of bevel protractor.

II. ANSWER THE FOLLOWING:

1. Make a list of reasons for valve leakage in a vehicle.

If the combustion gases leaks from valve, then it may cause

- Excessive fuel consumption
- No pickup
- Engine do not take load
- Hard starting
- Valve sticks
- Engine overheats

2. What is poppet valve? Or what is the purpose of a valve?

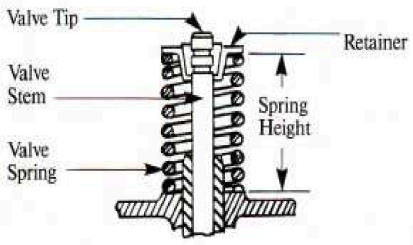
A poppet valve is a valve typically used to control the timing and quantity of gas. Or vapor flow into an engine.

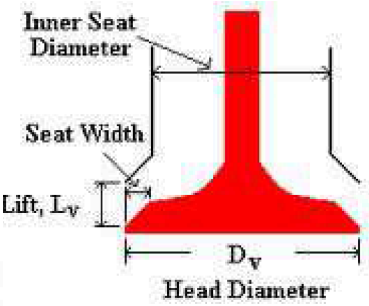
3. How many kinds of valve used in IC Engine?

Two types of valves used in engine are inlet valve and exhaust valve.

4. Briefly describe a function of a valve & draw its line diagrams with details?







Functions

- To control the timing and quantity of gas or vapor flow into an engine.
- To take the air fuel mixture into the cylinder and expel the exhaust gaseous.

5. What are the seat angles & why it is required?

ANS: Valve seat angle is related to both engine breathing performance and valve seat wear durability. Because, they are used to regulate the flow of liquid, gases, steam, vacuum and even aggressive fluids.

6. Which part control opening & closing of a valve?

ANS: Camshaft consists of several parts like camshaft journals, cam lobes.

7. What are the uses of valve mechanism and lit the types?

It controls submission of inlet gases and emission of exhaust gases at right time in relation with rotation of cam shaft. Valve mechanism are classified as given below

1. Overhead valve mechanism (OHV)
2. Overhead Cam mechanism (OHC)

8. What are main difference between overhead valve mechanism and overhead cam mechanism?

Overhead valve mechanism (OHV): It consist of inlet valve, exhaust valve, valve guide, valve spring lock, valve seat, push rod, and rocker arm and rocker shaft. In this case camshaft is fixed in the crankcase.

Overhead Cam mechanism (OHC): It consist of inlet valve, exhaust valve, valve guide, valve spring lock, valve seat, valve spring, rocker arm, and rocker shaft. In this case camshaft is fixed in the cylinder head.

9. Why reconditioning of valve is necessary and write the procedure?

To overcome leakages of combustion gases, valve reconditioning is required.

- Dismantle the cylinder head from the engine.
- Remove the carbon from the head, and piston head.
- Clean the piston head.
- Add little quantity of precision blue in petrol and with the help of dropper, put the mixture on the valve face.
- Remove the valves using a valve spring compressor, observe the valve leakage.
- Blue color shows leakage area.
- Clean the valves with a wire brush

10. Write the name of the tools required for valve seat grinding?

- Bevel protractor * Grinder *Cutter.

11. Write the procedure for resurfacing the valve.

- Inspect the valve run out if it is more than 2 degree
- Inspect the valve margin if it is less than 2 mm then it is necessary to replace the valve
- Place the valve on valve resurfacing machine.
- Set the machine at the angle between 35 to 45 degree,
- Start the machine,
- Open the coolant supply and start resurfacing operation slowly.

12. Write the procedure for valve seat cutting and grinding operations.

- Measure the angle of valve seat with help of bevel protractor,
- Check the margin of valve seat, If it is less than 2 mm replace the valve seat.
- If it is more than 2mm then it is suggested to carryout valve seat grinding operation,
- Select grinder/ cutter of appropriate size and angle,
- Fix the holder and pilot to the grinding stone/cutter,
- Now grind the valve seat with machine or manually and cut the valve seat to get required angle.

13. Write the procedure for valve lapping operations.

- Select the valve lapping stick of proper size,
- Place its rubber hide on the valve face,
- Apply abrasive/emery coarse paste on the valve face,
- Now turn the lapping stick in to clockwise and anticlockwise direction, this will lap valve with valve seat.

SESSION 2: REPLACEMENT OF PISTON RINGS

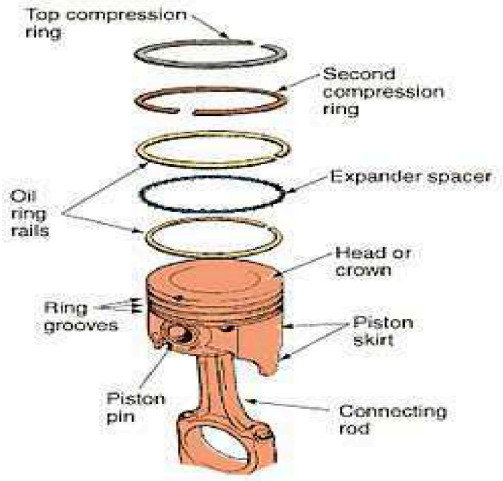
I. FILL IN THE BLANKS

1. A piston ring is a split ring which fits into a **grooves** of an internal combustion engine or steam engine piston.
2. Most automobile engine piston has **three rings**.
3. Compression ring withstands for more **pressure** and **temperature**.
4. Piston rings **expand** and **contract** during compression and exhaust stroke.
5. Two compression rings are used in most of the **internal** combustion engine.
6. Piston rings transfer heat from the **piston** to the cylinder wall.
7. Oil ring is also **replaced** when oil enters in combustion chamber and there is **increase** in the consumption of oil.

II. ANSWER THE FOLLOWING:

1. Make a list of steps required to measure the clearance between piston and cylinder wall.





- Place the vehicle on level ground.
- Remove the negative terminal of the battery.
- Keep a tray below the engine.
- Take the spanner and remove the drain plug.
- Allow all the oil to flow out of the engine into the tray and keep the tray aside.
- Remove the connection of radiator hoses, pipe from water pump also.
- Take out the radiator by unscrewing the nuts/bolts.
- Take out the fan, and then remove the belt from pulley.
- Dismantle the water pump and keep aside.
- The alternator, starter motor is not necessary to remove out, keep it aside on the chassis.
- Then from underneath remove the nut of the sump using ring spanner.
- Remove the oil sump.
- Then remove the tapped cover.
- Now remove the induction manifold.
- Using 14-15 ring spanner remove the connection of fuel line pipe and keep aside.
- Then remove the engine heater connection and lose the heaters.

2. How many types of rings used in piston?

ANS: Three rings (Two Compression Ring and One Oil Ring).

3. How much the clearance provided in the cylinder bore?

ANS: The minimum clearance provided in the cylinder bore is 54.02mm.

4. **What is the function of compression rings?**
   ANS: The main function of compression ring is to trap combustion gases and increase the combustion pressure and efficiency**.**

5. **What is the function of oil control ring?**
   ANS: To control the supply of oil to the cylinder wall and in order to lubricate the piston skirt and oil control ring.

6. **What is the position of the ring in the piston?**
   ANS: Two rings (Compression Rings) are positioned near to TDC and One Ring (Oil Ring) is positioned near to BDC.

7. **How to check the end gap, side gap and piston clearance?**

END GAP

- Take the piston ring and place it in cylinder bore at TDC.
- Align and level the piston ring with the help of piston.
- Take the feeler gauge and slide it in place between the end gaps of the ring.
- Take the micrometer and measure the feeler gauge.
- Note the reading.

SIDE GAP

- Take the piston and piston ring.
- Take any one piston ring on the ring groove with feeler gauge.
- Then take the micrometer and measure the feeler gauge.
- Note down the reading.

PISTON CLEARANCE

- Take the piston out from the respective cylinder.
- Place the piston in the respective cylinder bore with feeler gauge.
- Use micrometer to measure the feeler gauge thickness.
- The measured thickness is known as piston clearance**.**

SESSION 3: INSPECTION AND REPLACEMENT OF CYLINDER LINER/ BORE SLEEVE, CONNECTING ROD AND ENGINE BEARING

I. FILL IN THE BLANKS

1. Always replace the bend or **twist** connecting rod.
2. Turn the crank shaft, if run out is noticed more than **0.06mm**, then it is need to regrind the crank shaft.
3. The permissible value of ovality is **0.01** mm to **0.015** mm.
4. The permissible value of tapernes is **0.01** mm to **0.015** mm.

II. ANSWER THE FOLLOWING:

1. **Make a list of steps required for inspection and replacement of cylinder liner/ bore sleeve.**
   - Place the engine block on the press.
   - Use special tool as per the size of cylinder bore.
   - Support the engine block properly and rigidly fix on the press.
   - Apply pressure of 0.2 to 0.5 tone for dry liner of B.D.C.
   - The old sleeve will come out from engine block
   - Select new standard size bore sleeve with standard piston and rings.
   - Place the sleeve in liquid hydrogen where it will become easy to place in the engine block bore.
   - Place the sleeve on the engine block from the cylinder head side.
   - Operate the press slowly with pressure of 0.1 to 0.3 tone the sleeve will easily enter in the engine block.
   - Inspect the height of the sleeve in engine block with machinist edge and feeler gauge.
   - Maintain equal height for all cylinders.
   - Clean and lubricate the bore
   - Check piston clearance with the help of feeler gauge..
   - Repeat the same for all sleeves.

2. **What is the function of connecting rod?**
   Connecting rod is an engine component that transfers motion from piston to the crank shaft and functions as a lever arm.

3. **Why do some connecting rod have hole drilled from small end to the big end bearing?**
   Because small end bearing is connected to piston with the help of piston pin and big end bearing is connected to crankshaft with the help of gudgeon pin.

4. **Which part is connected to the small end of the connecting rod?**
   Piston Pin

5. **Which part of connecting rod is connected with crankshaft?**
   Big end bearing

6. **How to check bend in connecting rod?**
   To check the bend in connecting rod with the help of a rod checker (Rod Alignment) and Twist checker

7. **How to check clearance between connecting rod and crankshaft?**
   Feeler gauge and Micro meter

SESSION 4: TESTING OF COOLING SYSTEM AND REPLACEMENT OF DEFECTIVE COMPONENTS

I.FILL IN THE BLANKS

1. In I.C. engine during power stroke, the engine temperature reaches between 700 to 900 ºC.
2. In a vehicle, most of the energy of fuel (approx. 70%) is converted into heat, and it is the job of the cooling system to take care of that heat.
3. The primary job of the cooling system is to keep the engine from overheating by transferring this heat to the air.

II. ANSWER THE FOLLOWING:

1. Make a list of common faults in cooling system

- Loose or broken water pump pulley
- Low level of coolant
- Faulty thermostat
- Faulty water pump
- Faulty radiator cap
- Coolant leakage on cooling system
- Defective cooling fan motor
- Improper Ignition timing
- Faulty Thermostatic switch

2. Why the cooling system is important in I C Engine?

The primary job of the cooling system is to keep the engine from overheating by transferring this heat to the air.

3. Name the different component of cooling system

- Radiator *Cooling Fan *Thermostat *Reserve Tank *Water Pump *Pressure cap *Hoses

4. Name the different methods of engine cooling.

- Air cooling
- Water cooling
- Liquid cooling
- Pressure sealed cooling

5. Difference between oil cooling system and water cooling system.

Oil cooling system: Oil cooling is the use of oil as a coolant, typically to removes surplus heat from an internal combustion engine.

Water cooling System: Water cooling system is a system used to supply water from radiator to engine water jacket to maintain optimum temperature.

6. What is the function of radiator in cooling system?

The radiator transfer the heat from the fluid inside to the air outside, which in turn cool the engine and also cool automatic transmission fluid.

7. Why coolant is added in the radiator?

The purpose of coolant is to add to absorb the excess heat from the engine part and carry it via passageways and tubes to the radiator where the excess heat release to the atmosphere.

8. What is the function of thermostats?

The function of thermostat is to control the temperature difference between engine and radiator.

9. What is the function of water pump and cooling fan?

Water Pump: The function of water pump is to push coolant through the engine block, radiator and hoses to get the engine heat away from the system.

Cooling Fan: The cooling fan is temperature controlled to only run when needed.

SESSION 5: REGULAR SERVICING OF MPFI SYSTEM

I. FILL IN THE BLANKS

1. Sensors sense different **parameter** of the engine and send **signal** to ECM.
2. Actuators receives control signal from ECM and does **function** accordingly.
3. Processor collects all the data from **sensor** and **process**, takes appropriate decision.
4. The function of ECM is to receive signal from various **sensor**, manipulate the signals and send control signals to the **actuators.**
5. MPFI system is also called **motronic** engine management system.

II. ANSWER THE FOLLOWING:

1. Make a list of advantages of MPFI system

- More uniform Air-Fuel ratio will be supplied to each cylinder, hence the difference in power developed in each cylinder is minimum.
- No need to crank the engine twice or thrice in case of cold starting as happens in the carburetor system.
- Immediate response, in case of sudden acceleration / deceleration.
- Since the engine is controlled by ECM* (Engine Control Module), more accurate amount of A/F mixture will be supplied and as a result complete combustion will take place.
- The mileage of the vehicle will be improved.

2. What is the full form of MPFI?

MPFI – Multi Port Fuel Injection

3. What are main components of MPFI?

ECM, Sensor, Actuators and Processor

4. What are the advantages of MPFI over Conventional System?

- More uniform Air-Fuel ratio will be supplied to each cylinder; hence the difference in power developed in each cylinder is minimum.
- The mileage of the vehicle will be improved**.**

5. What are the disadvantages of MPFI over Conventional System?

In this system each cylinder has number of injectors to supply/spray fuel in the cylinders as compared to one injector located centrally to supply/spray fuel

6. What precaution to be taken while working on MPFI system?

- Always remove wire from spark plug.
- Do not check for spark with spark plug removed
- Do not tamper with springs.
- Do not modify this system in any way.
- Ensure that all the fuel and oil has been removed from the engine.

7. What is Sensor?

Sensing different parameters (Temperature, Pressure, Engine Speed etc.) of the engine and send to ECM. Some of the important sensor are crank angle sensor (CKP), cam sensor, throttle position sensor, AMF (Air mass flow) sensor, coolant temperature sensor, oxygen (lymda) sensor etc.

8. What is Actuator?

Receives control signal from ECM and does function accordingly. (ISCA, PCSV, Injectors and Power Transistor etc.) Important actuators are fuel injector, immobilizer unit, body control module, motorized headlight, fuel pump etc.

9. What is ECM?

The function of ECM is to receive signal from various sensors, manipulate the signals and send control signals to the actuators.

10. Write the two name of sensor used in MPFI?

Cam sensor and coolant temperature sensor

11. Write the importance of throttle body.

Throttle body is very important part of air supply system to the engine. It should be regularly cleaned. Due to carbon deposit inside the throttle valve and backfire. Throttle body (Butter fly) can be cleaned by carbo cleaner.

SESSION 6: CRDI AND NON CRDI SYSTEM

I. FILL IN THE BLANKS

1. In common rail fuel injection system a **single** injection pump with injector called as unit **injector** is employed on each.
2. In individual pump fuel injection system fuel is drawn from the **fuel tank** by means of fuel feed **pump** which is operated from the injection pump **camshaft**.
3. To inject the fuel in the **cylinder** in properly, atomized form and in proper quantity, fuel injector **nozzle** is used.
4. Nozzle consist of small **hole** which helps in **spray** of the fuel.
5. A turbo charger or turbo is a forced **injection** device used to allow more power to be produced by an **engine** of a given size.
6. Turbo chargers are popularly used with petrol and diesel **internal** combustion engines.

II. ANSWER THE FOLLOWING:

1. Make a list of components of CRDI system

- Storage of fuel(Fuel tank)
- Filtering of fuel(Fuel filter, sedi meter)
- Delivery of fuel to injection pump (Primary pump)
- Injecting the fuel into engine cylinder(rail assembly, unit injector, high pressure pump)
- Controlling the engine speed (ECM operated)

2. What is the full form of CRDI?

CRDI - Common Rail Direct Injection

3. What are the Advantages of CRDI over Conventional Diesel system?

- Reduced noise and vibration
- Reduced smoke, particulate and exhaust.
- Increased fuel economy
- Higher power output even at lower RPM

4. What are the disadvantages of CRDI over Conventional Diesel system?

- High cost due to high pressure pump & ECU
- Technology cannot be employed in present engine

5. What precaution to be taken while working on CRDI system?

- Smokes anywhere near an engine with suspicion of a diesel tank.
- Do not carry out repairs until fuel injection pressure has dropped to zero.
- Do not carry out repairs to injection equipment with engine running
- Always consult vehicle dealers if any doubt as to correct procedure.

6. List the types of CRDI.

Common Rail Fuel Injection system: In this type of system a single injection pump with injector called as unit injector is employed on each cylinder. These unit injectors are operated by rocker arms & springs similar to engine valves.

Individual Pump Fuel Injection system: In this system fuel is drawn from the fuel tank by means of fuel feed pump which is operated from the injection pump cam shaft. The fuel injection pump then injects definite quantity of fuel into individual cylinders according to firing order through injectors fitted on them. It is also known Non CRDI system.

7. Explain the use of fuel injector nozzle

To inject the fuel in the cylinder in properly, atomized form and in proper quantity, fuel injector nozzle is used. Nozzle consist of small holes which help in spray of the fuel.

8. Explain the use of turbo charger.

Turbo Charger: A turbo charger or turbo is a forced induction device used to allow more power to be produced by an engine of a given size. A turbocharged engine can be more powerful and efficient than a naturally aspirated engine because the turbine forces more air (oxygen), and proportionately more fuel, into the combustion chamber than atmospheric pressure alone.

9. How to Servicing of turbo charger?

Normally turbochargers are working at 150000 rpm. Servicing of turbocharger is not recommended by the manufacture but if the oil seal failure occurs than complete turbocharger assembly is replaced. Precaution to be taken not came across dust entry while disassembly of turbocharger

UNIT – 06

SUSPENSION SYSTEM

SESSION 1: MAINTENANCE OF SUSPENSION SYSTEM

I.FILL IN THE BLANKS

1. The shock absorbers on a vehicle go through as many as **one thousand** movements per kilometer.
2. The springs support the **weight** of vehicle act as a flexible link that allows the body and frame to ride with minimal disturbance.
3. Suspension keeps the vehicles tyres in contact with the **road surface**.
4. Suspension is very important to the **safety** and **performance** of vehicle.
5. Most of the suspension parts are made of **rubber** material to minimize **shocks**.

II. ANSWER THE FOLLOWING:

1. **Make a list of important functions of suspension system of a vehicle.**
   - Maintaining the correct vehicle ride height
   - Reducing the effect of shock forces to the vehicle
   - Maintaining the correct wheel alignment
   - Supporting the vehicles driving stability
   - Keeping the vehicles tyres in contact with the road
   - Control of vehicle's direction of travel.
   - Maintain the centre of gravity, when vehicle is moving.

2. **Why is suspension system required in a vehicle?**
   The function of keeping the tyres evenly connected with the road and maintaining a vertical load on the tyres.

3. **Name different components of a suspension system?**
   Vehicle's suspension system is made up of four basic components namely the struts, shock absorbers, springs and tyres.

4. **Make a list of maintenance tips for suspension system.**
   - Thoroughly clean the leaf spring set and its fittings,
   - With the help of grease or pneumatic grease gun, lubricate all shackle pins, swing arm of the leaf spring set,
   - Lubricate each leaf with graphite grease,
   - Tighten the u clamp bolts /nuts with specified torque,
   - Check the centre bolt,
   - Tighten the clamp nut bolt with specified torque,
   - Check the slackness of shackle and tighten the set if needed
   - In case of shock absorber/stud, tighten the holding nuts and bolts at both ends
   - In case of two wheeler, tighten the swinging of nuts/bolts of front and rear wheels,
   - Avoid overloading vehicle.
   - Avoid sudden acceleration and breaking.

5. **How to Servicing of suspension system**
   The shock absorbers on a vehicle go through as many as one thousand movements per kilometer so it is not surprising that they wear out quite quickly and should be checked every 20,000 kilometers during major servicing.

SESSION 2: SERVICE AND REPLACEMENT OF LEAFS, CAMBERING OF LEAF SPRINGS, SHACKLE, SHACKLE PIN AND CENTRE BOLT

I. FILL IN THE BLANKS

1. A leaf spring is a simple form of **spring** commonly used for the suspension in **wheeled** vehicles.
2. A leaf spring takes the form of a slender arc-shaped length of **spring** steel of rectangular cross-section.
3. Leaf springs can serve **locating** and to some extent **damping** as well as springing functions.
4. The leaf spring acts as a linkage for holding the axle in position and thus separate **linkage** are not necessary.
5. Cambering helps to reduce the **flexibility** of spring.
6. A spring shackle is a device found on leaf-spring **equipped** vehicles.
7. Centre bolt holds the **bunch** of leaf together to bear the **shocks**.

II. ANSWER THE FOLLOWING:

1. Why leaf springs are provided in vehicle, state its functions?

- The leaf spring acts as a linkage for holding the axle in position and thus separate linkage are not necessary. It makes the construction of the suspension simple and strong.

2. Sate the role of leaf spring in a vehicle?

- As the positioning of the axle is carried out by the leaf springs so it makes it disadvantageous to use soft springs i.e. a spring with low spring constant.
- The inter-leaf friction between the leaf springs affects the riding comfort.

3. Describe the functions of shackle.

- To allow different mounting heights.
- The shackles allow for movement of the suspension by pulling in or pushing out as the suspension travels through its up and down cycle.

4. Describe the functions of center bolt.

It holds the bunch of leaf together to bear the shocks. If it is broken, it will leads to vehicle pull to one side, It is necessary to replace immediately.

5. What tools and equipment are required for servicing of leaf spring system.

Chassis jack/hydraulic jack, screw jack, supporting stands, Socket spanner set, Open end spanner, DE ring spanner, spring clamp, anvil, hammer

6. What is meaning of leaf spring?

A leaf spring is a simple form of spring commonly used for the suspension in wheeled vehicles, sometimes referred to as a semi-elliptical spring or cart spring, it is one of the oldest forms of springing, dating back to medieval times.

7. What is meaning of shackle?

A spring shackle is a device found on leaf-spring equipped vehicles. The spring shackle mounts to one end of the leaf spring and allows it to flex and move while keeping the tire on the road.

8. List the precautions to be taken while servicing, maintenance and repair of leaf spring.

- Fix the spanners properly.
- Use special jack and the stand to support the spring.
- While disassembling the leaf spring, fix it on the vice and disassemble it.
- Place the every nut/bolts properly in the tray.
- Support the chassis and axle with stand before removing it from the chassis.
- Tighten the nut/bolts to the specified torque.

9. Make a list of steps to carry out the servicing, maintenance and repair of leaf spring.

- Keep the vehicle on plane hard surface.
- Disconnect the negative terminal from the battery.
- Take the stand and support the chassis at appropriate height.
- Take the stand and support the axle/axle beam.
- Using appropriate spanner loosens the nuts and removes the ‘U’ clamp bolts.
- Remove the shackle pin from the chassis fixed end.
- Slowly dismount the spring assembly set from the chassis.
- Take the leaf spring set and place it on the workbench.

- With proper precaution, place the leaf spring in the spring vice and remove the Centre bolt.
- Separate the spring leaves and place it in proper order.
- Clean the leaves thoroughly.

SESSION 3: REPLACEMENT OF STRUT/SHOCK ABSORBERS, INSPECTION OF STEERING LINKAGES

I.FILL IN THE BLANKS

1. A shock absorber is a mechanical device designed to smooth out or damp **shock** and dissipate **energy.**
2. Suspension system has damper with **spring.**
3. Every shock up/ **suspension** has its own life.

II. ANSWER THE FOLLOWING:

1. Make a list of steps to carry out the testing of shock absorber off the vehicle.

- Keep the vehicle on level ground
- Jack up the vehicle at the certain height to make the wheel free to rotate
- Loosen the wheel nut and remove out the front wheel
- Remove brake drum with bearing from stub axle by using hub puller
- Remove the brakes pins/ bolts from strut bracket
- Remove the strut bracket bolts
- Remove support nuts by supporting the strut properly
- Dismount the strut assembly from the vehicle
- Use a spring compressor to remove the strut spring
- Fix the spring compressor on the strut and compress the spring

2. Make a list of steps to carry out the testing of shock absorber on the vehicle.

1. Keep the vehicle on the level ground,
2. Press the front portion of the car with gentle pressure,
3. Now feel resistance in the up and down movement of front portion,
4. If notice any jerking movement, indicates defect in shock absorber,
5. Release the pressure and experience, upward movement with same resistance,
6. If it feels hard, noisy and stucked /binding at any movement indicate faulty shock up.
7. Visually inspect the shock up for fluid leakage if found, replace it

3. Describe the uses and applications of shock absorbers?

To reduce the effect of traveling over rough ground, leading to improved ride quality and vehicle handling. Every shock up/suspension has its own life.

4. Sate the reasons which affect life span of shock absorbers?

- Overloading
- Road conditions
- Worn-out Linkage/bushes
- Leakage of fluid/gas
- Broken casing
- Deterioration of Bump stopper
- Rubber bellows
- Improper handling in service

5. What tools and equipment are required for servicing of shock absorber.

- Open end spanners, ring spanner, tubular spanner, locking clamps, screw drivers etc.
- Oil, grease, metal tray, bolts waste, equivalent parts etc

SESSION 4: INSPECTION OF STEERING LINKAGE

I.FILL IN THE BLANKS:

1. A steering linkage is the part of an automotive steering system that connects to the **front** wheels.
2. Regular Inspection of steering linkage is necessity to maintain **safety** and **control** the vehicle.

II. ANSWER THE FOLLOWING:

1. Make a list of steps to carry out the inspection of steering linkages

- Lift the front portion of the car/vehicle,
- Turn the steering wheel from one lock end to another lock end,
- Check for noise and binding in-steer.
- If the binding is traced, remove the drag link connection from steering gearbox.
- Now rotate the steering wheel in both the direction and trace for the binding. If the binding is noticed then it probably lies in the steering gear box.
- If the binding is not traced in steering gear box then problem is in steering linkage.
- Inspect the ball joint if it is worn out or bellow torned then replace it.
- Inspect the bushes of the torsion bar and replace it.
- Inspect the draglink, tie rod for its straightens.
- Remove the bush by using special tool and replace the same.

2. Make a list of precautions to be taken while inspection of steering linkages

- Fix the spanner properly.
- Keep the removed nut bolts properly.
- Handle the pots carefully.
- Support the chassis properly with stand.

3. What is meaning of steering linkage?

A steering linkage is the part of an automotive steering system that connects to the front wheels. Steering linkages consist of drag link (pitman arm), tie rod, ball joint, end joint, arm assembly, torsion bar, and steering shock absorber, bushes of steering axis, steering arm and stub axle.

4. **What are functions of steering linkages?**

The function of steering linkage is to maintain safety and control of the vehicle.

SESSION 5: MANUAL AND POWER STEERING SYSTEM

I. FILL IN THE BLANKS

1. Rack and pinion type of steering gear is used for **light** vehicles and in **power** steering.
2. In hydraulic operated power steering, fluid is **pressurized** through a centrifugal pump.
3. The centrifugal pump is driven by the engine **crankshaft** through v belt.
4. EPS uses as electric **motor** to assist the driver of the vehicle.
5. Air suspension is a type of vehicle suspension **powered** by an electric or engine driven **air pump** or compressor.
6. The purpose of air suspension is to **provide** a smooth, **constant** ride quality and in some cases it is self-leveling.

II. ANSWER THE FOLLOWING:

1. **In automobile different types of steering are used. Make a list of types of steering.**
   - Worm and roller shaft
   - Worm and nuts
   - Rack and pinion
   - Worm and sector

2. **Make a list of steps followed for servicing of rack and pinion type of steering.**
   - Conduct the road test and mark the central or the mid position of the road wheels
   - and the steering gear box,
   - Raise the front portion of a car and turn the steering wheel,
   - To check for the binding in the steering,
   - If binding is traced then the fault is in the steering gear box, and need to service
   - the steering gear box,
   - Disconnect the electric connections from the steering wheel,
   - Using specified spanner remove the steering wheel nut from the steering shaft,
   - Use special tool to remove the steering wheel,
   - Remove the steering gear mounting bolts and dismount the steering gear box from the chassis.

- Clean the external portion of the steering box,
- Remove the side cover from the steering gear box,
- Remove the cross shaft from the steering gear box casing,
- Loosen the steering column bolts and remove it out.

3. Describe the procedure for servicing of the manual steering system.

Same as question no 2

4. Describe the procedure for servicing of rack and pinion type of steering.

- Slide driver seat as back as possible.
- Put off the front part of floor mat on the driver side and remove steering shaft joint cover.
- Remove the steering shaft lower joint bolt and disconnect lower joint bolt form pinion.
- Hoist car at appropriate height and remove both wheels.
- Remove quarter pin/split pins and tie rod castle nuts from both knuckles.
- Disconnect both tie rod ends from knuckle using special tool.
- Remove steering gear cage mount bolts gear cage brackets and then gear case.
- Remove the rubber boot wire clip and remove the rubber boot from the tie rod.
- Unbend parts of tie rod lock washer and remove tie rod from rack.
- Remove the rack damper screw cap, damper screw and remove the plunger from steering rack.

5. State types of powers used in operation of power steering.

- Hydraulic operated power steering:
- Electronic power assisted steering system EPS

6. Describe the procedure for inspection of power steering.

- Park the vehicle on the level ground
- Switch off the engine and check the oil level in power steering container
- It should be between minimum and maximum level
- Type of fluid is known as power steering fluid
- Check power steering hose connections for leakage/damages/cracks
- Check and replace fluid filter at regular interval as per service manual.
- Inspect the functioning of centrifugal pump in turning of vehicle, if faulty replace the pump
- Carry out bleeding operation after each service

7. Describe principle of working of air suspension system.

Air suspension is a type of vehicle suspension powered by an electric or engine driven air pump or compressor. This pump compresses the air using compressor. Compressed air is sent to the balloon. Air suspension is used in place of conventional steel springs and in heavy vehicle applications such as buses and trucks. If the engine is left off for an extended period, the vehicle will gradually settle to the ground. The purpose of air suspension is to provide a smooth, constant ride quality and in some cases it is self-leveling. Now days gas filled shock absorber are being used for more comfort.

8. What is function of steering in vehicle?

The function of steering system is to turn the vehicle either left or right.

9. Write the name of components of steering system.

- Steering wheel

- Steering Column
- Rack and pinion
- Steering knuckle
- Steering gear
- Tie Rods

10. In modern vehicle which types of steering are used?

Power steering system

11. What are limitations of manual steering?

- It is bigger in size.
- At low speed, need to put in a lot of effort to turn the wheel.
- It is difficult to handle in city traffic conditions**.**

12. What are advantages of power steering over manual steering?

- Easy of operations (easy to turn)
- With less effort on the steering.
- Smoother than simple steering.
- More comfortable to driver

SESSION 6: STEERING SYSTEM ADJUSTMENTS

I. FILL IN THE BLANKS

1. Wheels which are out of balance generally produce a **vibration** that makes **uncomfortable** to drive a vehicle.
2. The first sign that wheels may be out of balance is when steering wheel starts to **wobble** at certain speed.
3. Wheel alignment consists of adjusting the **angle** of the wheels so that they are set to the manufacturer's **specification.**
4. When the wheels tilt out ward at top the camber is positive.
5. Toe-in is a measurement of how much the front and/or rear wheels are turned **in or out** from a straight-ahead position.
6. Toe in adjustment maintains the normal **wear** of the tyre.
7. Defined as the angle, created by the steering pivot point from the front to back of the **vehicle** is called **caster** angle.
8. The distance between the center of the front axle and the rear axle is called the wheel **-base**.
9. The improper wheel base causes **abnormal** tyre wear.
10. When the vehicle is steered the inner wheel turns an angle of **23** degrees the outer wheel turns an angle of **20** degrees.

II. ANSWER THE FOLLOWING:

1. Make a list of preliminary procedure for wheel alignment

- Check all tyres for the proper inflation pressure and also same tread wear
- Check for the run out of the tyre and wheel
- Check for the looseness of the ball joint
- Adjust the braking system
- Check and adjust the slackness of the suspension system
- Check for the loose of suspension arm
- Check for loose or missing stabilizer bar attachment

- Test for the binding in the steering gear
- Lubricate the ball joints and tighten the joints with specified torque
- Tighten the U Clamp Bolts at regular intervals.

2. Make a list of adjustments which can be done in steering gear

Worm shaft and play adjustments

- Hold the steering wheel by the right hand and with a left hand hold the steering column
- Now pull and push the steering shaft /worm shaft in and out
- If excessive play is noticed check the condition of the worm shaft bearings or add the shims again check the end play.

Cross shaft end play adjustments

- Loosen the adjusting nut of the cross shaft
- Now pull and push the cross shaft in and out
- If excessive play is noticed then tighten the stud and reduce the play
- After setting the play tighten the nut

3. What is the use of castor plate?

Caster is the forward and backward adjustment in the plates. The purpose of caster is to keep the tires as vertical as possible through a turn, to better grip and tractions.

4. Write the turning radius of two small cars?

The turning radius of two small cars as 35.5 feet (10.82m). It is often used as a generalized term rather than a numerical figure

5. What is a Wheel Balancing/Wheel alignment?

Wheel balancing is the process of balancing the weight of a tire and wheel assembly so that it travels evenly at high speeds.

6. Why wheel balancing is required in a vehicle?

To eliminate vibration and avoid premature wear caused by an imbalance in the rotating wheel and tyre assembly.

7. How dynamic balancing of wheel is carried out with the help of balancing machine?

Wheels are balanced on a wheel balancing machine. The machine rotates the wheel assembly and automatically calculates the weight and location of the balance counter, As a result of wheel balancing, one will feel a smoother ride and low wear from tyres.

8. Write the symptoms of imbalanced wheel in the vehicle?

- Faster thread wear
- Poor fuel economy
- Tires are uneven
- Vibration in the steering wheel

9. What are the ill-effects, if wheels are not properly balanced in a car?

- Faster thread wear
- Poor fuel economy
- Tires are uneven
- Vibration in the steering wheel

10. What do you understand by toe-in and toe-out?

Toe – in: Toe-in is a measurement of how much the front and/or rear wheels are turned in or out from a straight-ahead position. When the wheels are turned in, toe is positive (+). When the wheels are turned out, toe is negative (-).

Toe – out: Is a the difference in angles between the front two wheels during a turn, steering system is designed to turn the inner wheel at more angle then the outer wheel.

11. What is castor angle and how does it affects steering system?

- Defined as the angle, created by the steering pivot point from the front to back of the vehicle. Caster is positive if the line is angled forward, and negative if backward.
- Caster is affected by the vehicle height, therefore it is important to keep the body at its designed height.

12. What is camber angle and how does it affects steering system?

- Camber is the tilting of the front wheels from the vertical
  - When the wheels tilt out ward at top the camber is positive
  - When the wheels tilt inward ward at the top, the camber is negative
  - Camber maintains the directional stability
- The change in the camber causes due to damaged, loose, bend, dented or worn out suspension parts and they should be replace.