MECHANICAL WORKSHOP MANUAL

3RD SEM ELECTRICAL

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LECT. IN MECHANICAL

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CARPENTRY

Introduction

Carpentry may be defined as the process of making wooden components. It starts from a marketable form of wood and ends with finished products. It deals with the building work, furniture, cabinet making. etc. Preparation of joints is one of the important operations in all woodworks. It deals with the specific work of carpenter like making different types of joints to form a finished product.

Timber:

Timber is the name given to the wood obtained from well grown trees. The trees are cut, sawn into various sizes to suit building purposes. The word, 'grain', as applied to wood, refers to the appearance or pattern of the wood on the cut surfaces. The grain of the wood is a fibrous structure and to make it strong, the timber must be so cut, that the grains run parallel to the length.

Timber Sizes

Timber sold in the market is in various sizes and shapes. The following are the common shapes and sizes.

a. **Log -** The trunk of the tree which is free from branches.

b. Balk - The log, sawn to have roughly square cross section.

c. Post - A timber piece, round or square in cross section, having its diameter or side from 175 to 300mm.

d. Plank - A sawn timber piece, with more than 275 mm in width, 50 to 150 mm in thickness and 2.5 to 6.5 meters in length.

e. Board - A sawn timber piece, below 175 mm in width and 30 to 50 mm in thickness.

f. Reapers- Sawn timber pieces of assorted and non-standard sizes, which do not confirm to the above shapes and sizes.

Classification of Timber

Wood suitable for construction and other engineering purposes is called timber. Woods in general are divided into two broad categories: Soft woods and Hard woods.

Soft woods are obtained from conifers, kair, deodar, chir, walnut and seemal. Woods obtained from teak, sal, oak, shisham, beach, ash mango, neem and babul are known as hard wood, but it is highly durable.

Another classification of woods is based on the name of the trees like teak, babul, shisham, neem, kair, chir, etc.

Seasoning of Wood

A newly felled tree contains considerable moisture content. If this is not removed, the timber is likely to wrap, shrink, crack or decay. Seasoning is the art of extracting the moisture content under controlled conditions, at a uniform rate, from all the parts of the timber. Only seasoned wood should be used for all carpentry works. Seasoning makes the wood resilient and lighter. Further, it ensures that the wood will not distort after it is made into an object.

Characteristics of Good Timber

The good timber must possess the following characteristics

a. It should have minimum moisture content, i.e., the timber should be well seasoned.

b. The grains of wood should be straight and long.

c. It must retain its straightness after seasoning.

d. It should produce near metallic sound on hammering.

e. It should be free from knots or cracks.

f. It should be of uniform color, throughout the part of the wood.

g. It should respond well to the finishing and polishing operations.

h. During driving the nails and screw, it should not split easily.

Marking and Measuring Tools:

Accurate marking and measurement is very essential in carpentry work, to produce parts to exact size. To transfer dimensions onto the work; the following are the marking and measuring tools that are required in a carpentry shop.

Steel Rule and Steel Tape

Steel rule is a simple measuring instrument consisting of a long, thin metal strip with a marked scale of unit divisions. It is an important tool for linear measurement. Steel tape is used for large measurements, such as marking on boards and checking the overall dimensions of the work.

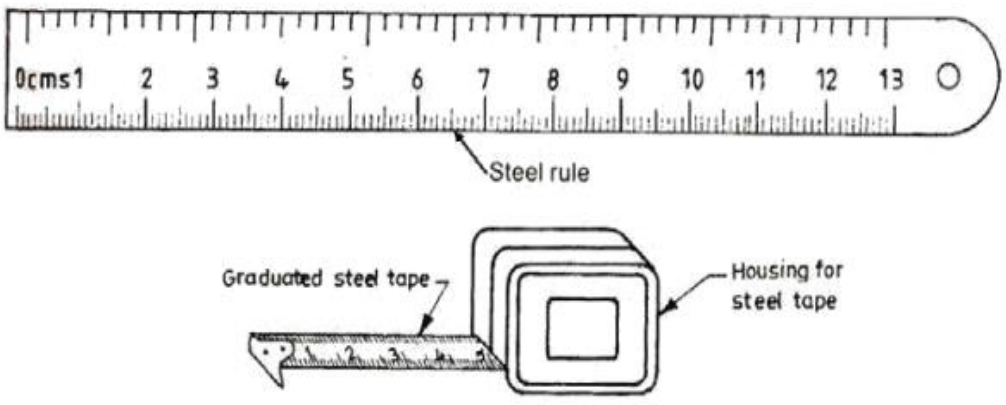
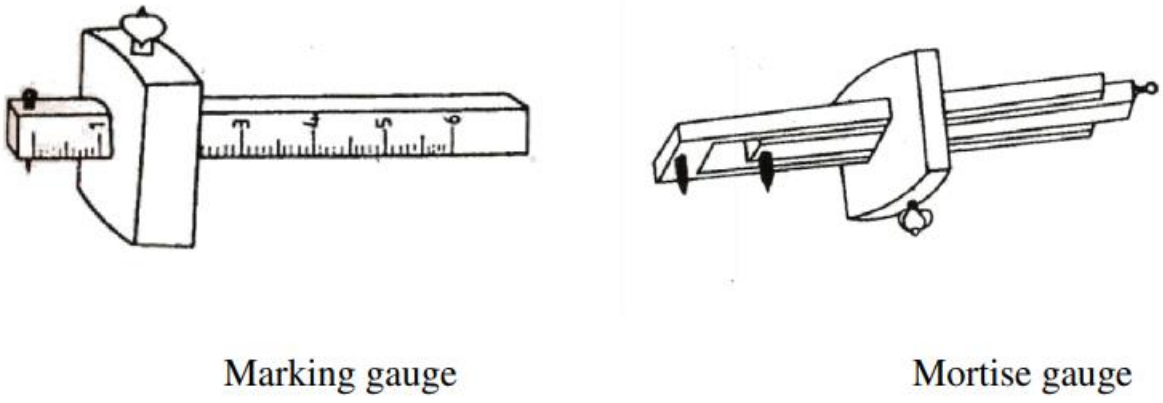


Fig: Steel Rule and Steel Tape

Marking Gauge

It is a tool used to mark lines parallel to the edge of a wooden piece. It consists of a square wooden stem with a sliding wooden stock (head) on it. On the stem is fitted a marking pin, made of steel. The stock is set at any desired distance from the marking point and fixed in position by a screw. It must be ensured that the marking pin projects through the stem, about 3 mm and the end are sharp enough to make a very fine line. A mortise gauge

consists of two pins. In this, it is possible to adjust the distance between the pins, to draw two parallel lines on the stock.

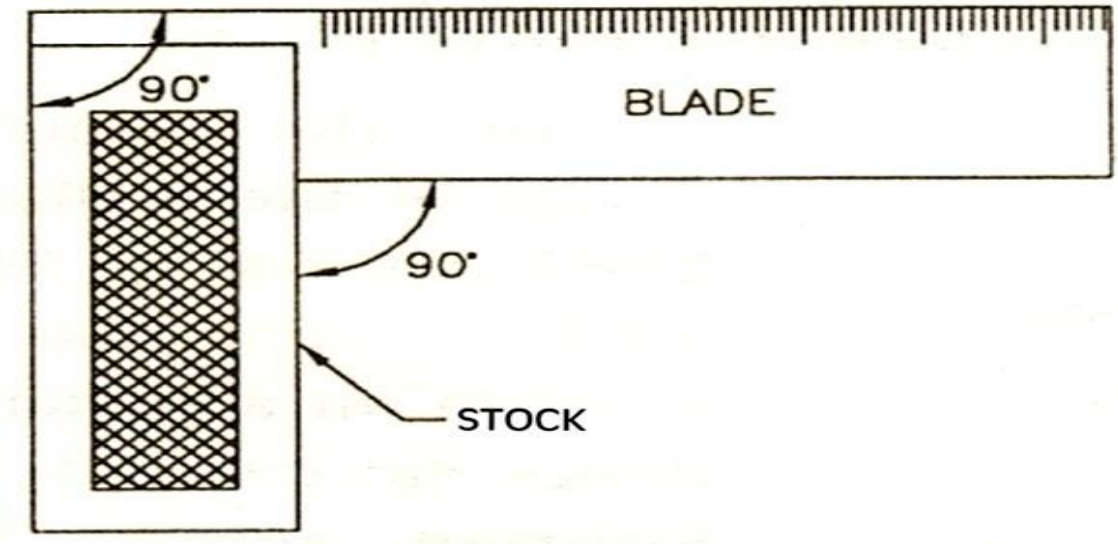


Marking gauge Mortise gauge

Fig: Marking Gauges

Try - Square

It is used for marking and testing the squareness and straightness of planed surfaces. It consists of a steel blade, fitted in a cast iron stock. It is also used for checking the planed surfaces for flatness. Its size varies from 150 to 300 mm, according to the length of the blade. It is less accurate when compared to the try-square used in the fitting shop.



Compass and Divider

Compass and divider, are used for marking arcs and circles on the planed surfaces of the wood.

Compass

Divider

Marking Knife

It is used for marking on timber. It is made of steel having one end pointed and the other end formed into a sharp cutting edge

Marking knife

Bevel Square

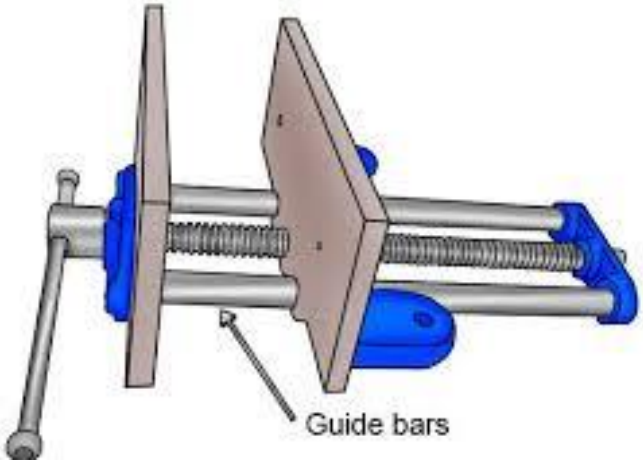
It is used for laying-out and checking angles. The blade of the bevel is adjustable and may be held in place by a thumb screw. After it is set to the desired angle, it can be used in much the same way as a try-square. A good way to set it to the required angle is to mark the angle on a surface and then adjust the blade to fit the angle.

Bevel square

Holding Tools:

Carpenter's Vice

It is used as a work holding device in a carpenter shop. Its one jaw is fixed to the side of the table while the other is movable by means of a screw and a handle. The Carpenter's vice jaws are lined with hard wooden' faces.



Carpenter’s vice

C-Clamp

It is used for holding small works

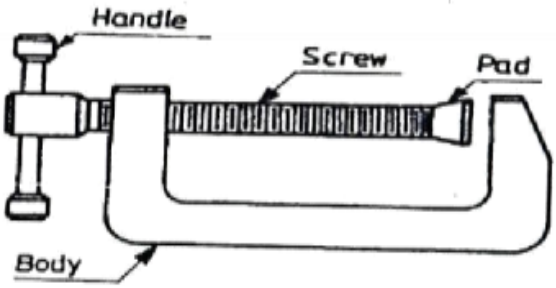


Fig: C-Clamp

Planing Tools:

Planing is the operation used to produce flat surfaces on wood. A plane is a hand tool used for this purpose. The cutting blade used in a plane is very similar to a chisel. The blade of a plane is fitted in a wooden or metallic block, at an angle.

Types of Planes:

Jack Plane

It is the most commonly used general purpose plane. It is about 35 cm long. The cutting iron (blade) should have a cutting edge of slight curvature. It is used for quick removal of material on rough work and is also used in oblique planning.

Smoothing Plane

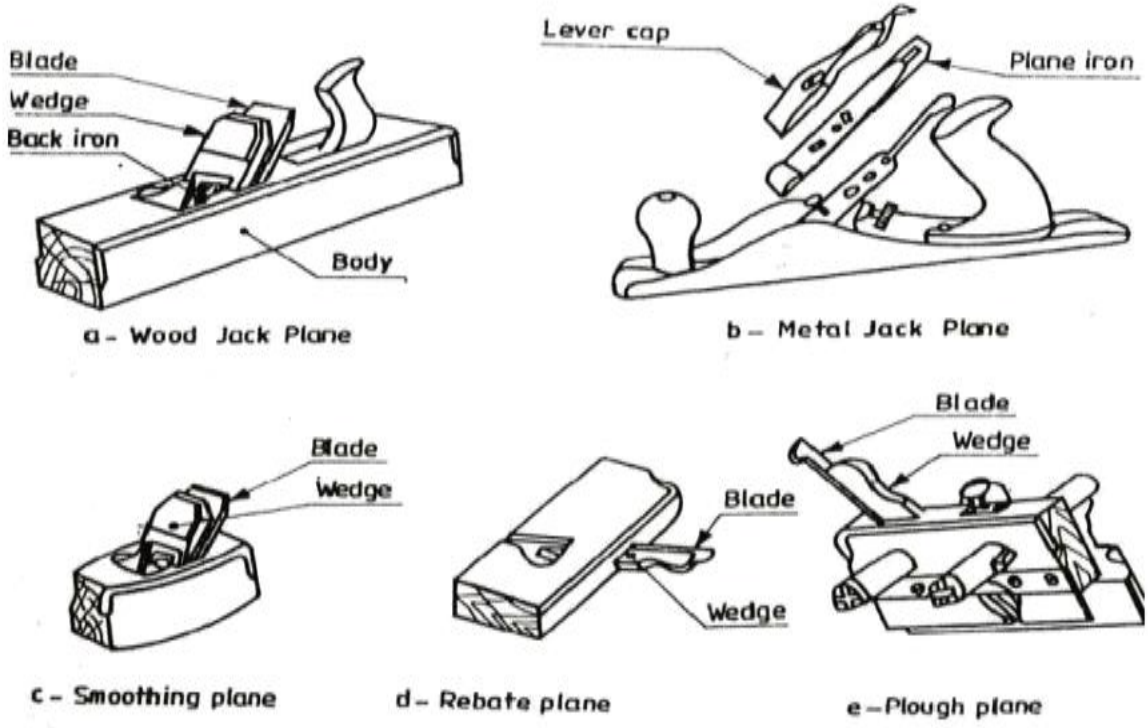
It is used for finishing work and hence, the blade should have a straight cutting edge. It is about 20 to 25 cm long. Being short, it can follow even the slight depressions in the stock, better than the jack plane. It is used after using the jack plane.

Rebate Plane

It is used for making a rebate. A rebate is a recess along the edge of a piece of wood, which is generally used for positioning glass in frames and doors.

Plough Plane

It is used to cut grooves, which are used to fix panels in a door.



Cutting Tools:

Saws

A saw is used to cut wood into pieces. There are different types of saws, designed to suit different purposes. A saw is specified by the length of its toothed edge.

Types of Saws:

Cross-Cut Saw or Hand Saw

It is used to cut across the grains of the stock. The teeth are so set that the saw kerf will be wider than the blade thickness. This allows the blade to move freely in the cut, without sticking

Rip Saw

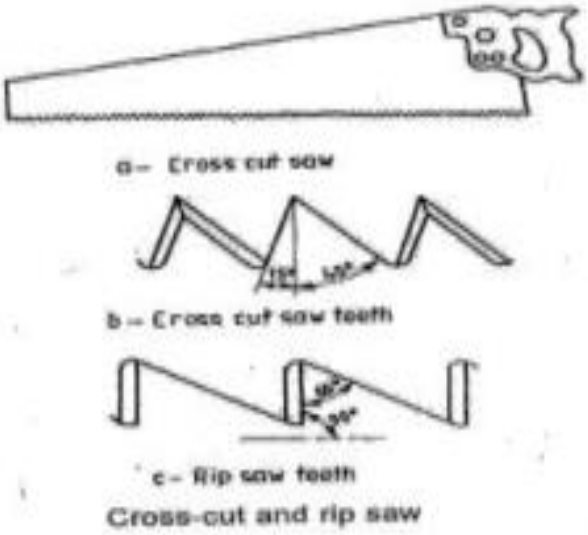
It is used for cutting the stock along the grains. The cutting edge of this saw makes a steeper angle, i.e., about 60° whereas that of crosscut saw makes an angle of 45° with the surface of the stock.

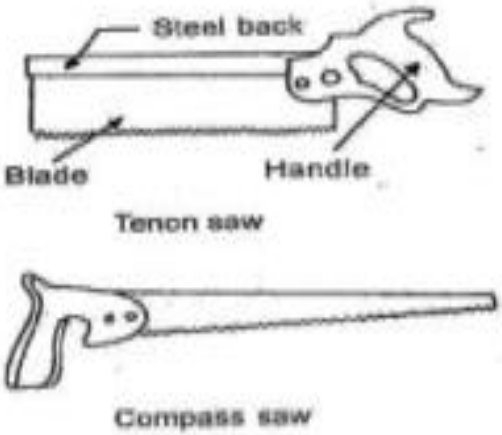
Tenon Saw

It is used for cutting the stock either along or across the grains. It is used for cutting tenons and in fine cabinet work. However, it is used for small and thin cuts. The blade of this saw is very thin and so it is stiffened with a thick back steel strip. Hence, this is sometimes called as back-saw. In this, the teeth are shaped like those of cross-cut saw.

Compass Saw

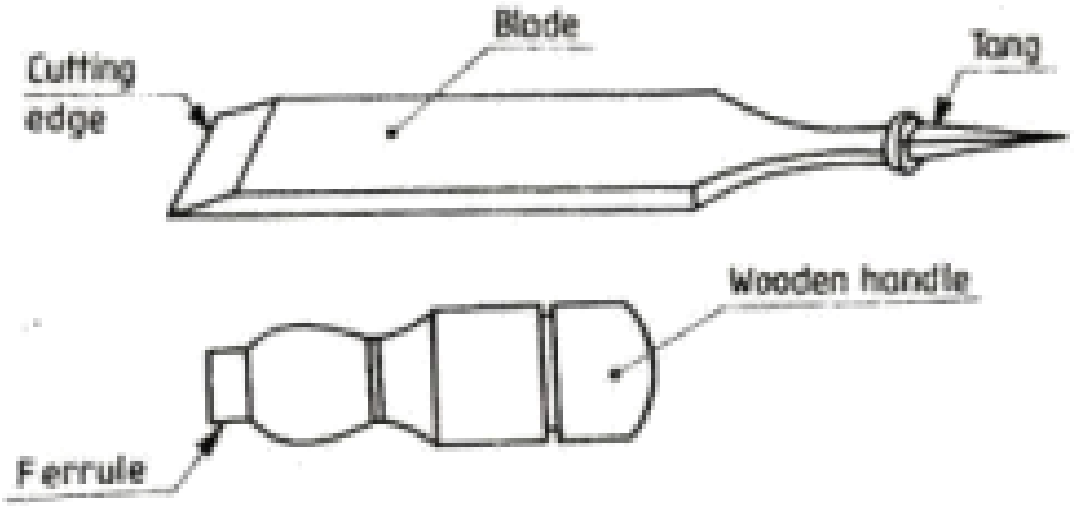
It has a narrow, longer and stronger tapering blade, which is used for heavy works . It is mostly used in radius cutting. The blade of this saw is fitted with an open type wooden handle.



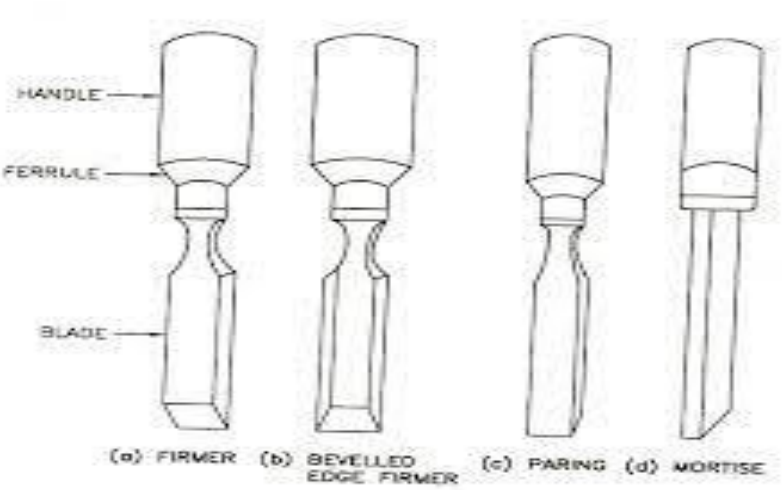


Chisels:

Chisels are used for cutting and shaping wood accurately. Wood chisels are made in various blade widths, ranging from 3 to 50 mm. They are also made in different blade lengths. Most of the wood chisels are made into tang type, having a steel shank which fits inside the handle. These are made of forged steel or tool steel blades.



Types of Chisels:



Firmer Chisel

The word 'firmer' means 'stronger' and hence firmer chisel is stronger than other chisels. It is a general purpose chisel and is used either by hand pressure or by a mallet. The blade of a firmer chisel is flat.

Dovetail Chisel / Bevelled edge chisel

It has a blade with a bevelled back, as shown in Figure, due to which it can enter sharp comers for finishing, as in dovetail joints.

Mortise Chisel

It is used for cutting mortises and chipping inside holes, etc. The cross-section of the mortise chisel is proportioned to withstand heavy blows during mortising. Further, the cross-section is made stronger near the shank..

JOB NO 1

AIM OF THE EXPERIMENT:

To make a T- Lap joint by using two given wooden blocks.

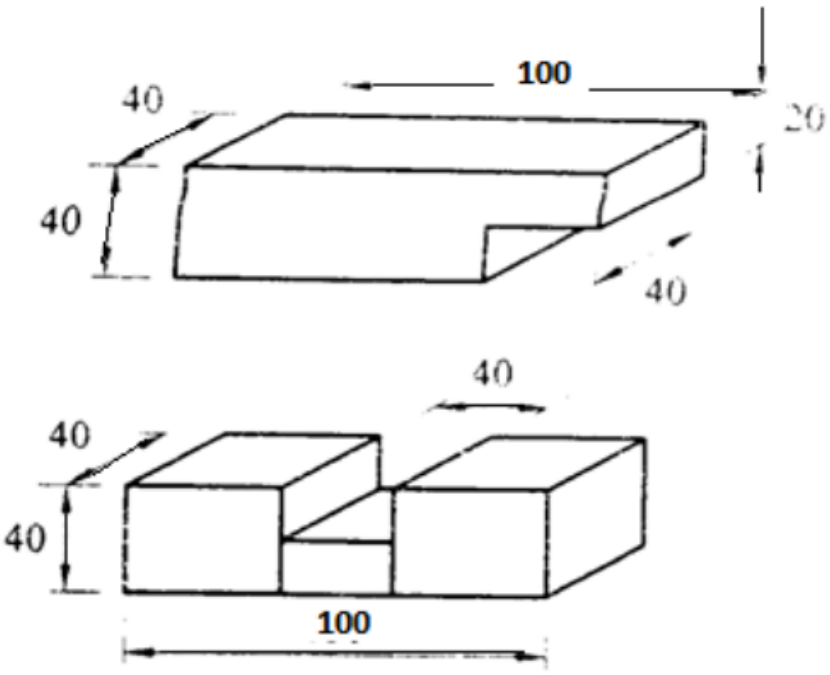
TOOLS AND EQUIPMENTS REQUIRED:

1. Carpenters vice,
2. Steel rule
3. Metal jack plane.
4. Try square
5. Marking gauge
6. Scriber
7. Cross cut saw
8. Firmer chisel.
9. Bevelled edge chisel.
10. Hammer

RAW MATERIAL REQUIRED:

Wooden block as per the given dimension – 2 pieces.

JOB FIGURE:



PROCEDURE:

- The given wooden pieces are checked to ensure their correct size.
- The piece is firmly clamped in the carpenter's vice and any two adjacent faces are planned by the jack plane and the two faces are checked for squareness with the try square.
- Marking gauge is set and lines are drawn to mark the thickness and width of the model.
- The excess material is first chiselled out with firmer chisel and then planned to correct size.
- The mating dimensions of the parts are then marked using scale and marking gauge.
- Using the cross-cut saw, the portions to be removed are cut in both the pieces, followed by chiselling and also the parts are separated by cross-cutting, using the tenon saw.
- The ends of both the parts are chiselled to the exact lengths.
- A fine finishing is given to the parts, if required, so that proper fitting is obtained.
- The parts are fitted to obtain a slightly tight joint.

PRECAUTIONS:

1. While fixing the job in the vice it should be fixed parallel to the jaws.
2. Uniform pressure should be applied while sawing
3. While cutting with saw, hold it be perpendicular to the job.
4. Chiselling is to be done carefully.

CONCLUSION:

The T lap Joint is thus made by following the above sequence of operations.

VIVA QUESTIONS

1. Name the commonly available shapes of timber in the market.
2. Classify wood used for construction purposes.
3. What is the difference between marking gauge and marking knife?
4. What is the difference between C-clamp and bar cramp?
5. What for a plane is used in a carpentry shop? VIVA QUESTIONS 1. Classify the planning tools. 2. Classify the chisels and their applications. 3. Name the tools used for pulling nails. 4. On what parameters does the strength of the joint depend? 5. Which process is used to remove moisture content in wood?

JOB NO. 2

AIM OF THE EXPERIMENT:

To make a Single Dovetail lap joint by using two given wooden blocks.

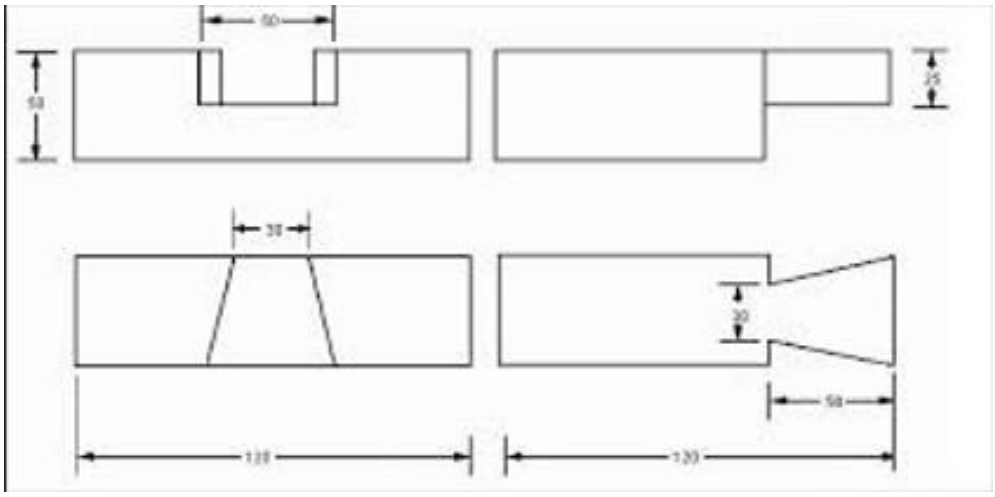
TOOLS AND EQUIPMENTS REQUIRED:

1. Carpenters vice,
2. Steel rule
3. Metal jack plane.
4. Try square
5. Marking gauge
6. Scriber
7. Cross cut saw
8. Firmer chisel.
9. Bevelled edge chisel.
10. Hammer

RAW MATERIAL REQUIRED:

Wooden block as per the given dimension – 2 pieces.

JOB FIGURE:



PROCEDURE:

- The given wooden pieces are checked to ensure their correct size.
- The piece is firmly clamped in the carpenter's vice and any two adjacent faces are planned by the jack plane and the two faces are checked for squareness with the try square.
- Marking gauge is set and lines are drawn to mark the thickness and width of the model.
- The excess material is first chiselled out with firmer chisel and then planned to correct size.

- The mating dimensions of the parts are then marked using scale and marking gauge.
- Using the cross-cut saw, the portions to be removed are cut in both the pieces, followed by chiselling and also the parts are separated by cross-cutting, using the tenon saw.
- The ends of both the parts are chiselled to the exact lengths.
- A fine finishing is given to the parts, if required, so that proper fitting is obtained.
- The parts are fitted to obtain a slightly tight joint.

PRECAUTIONS:

1. While fixing the job in the vice it should be fixed parallel to the jaws.
2. Uniform pressure should be applied while sawing
3. While cutting with saw, hold it be perpendicular to the job.
4. Chiselling is to be done carefully.

CONCLUSION:

The Single dovetail Lap is thus made by following the above sequence of operations.

JOB NO. – 3

AIM OF THE EXPERIMENT:

To make a Mortise and Tenon joint by using two given wooden blocks.

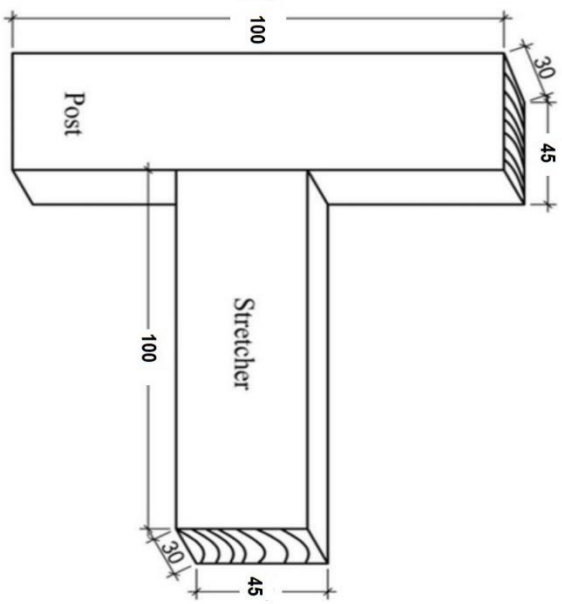
TOOLS AND EQUIPMENTS REQUIRED:

1. Carpenters vice,
2. Steel rule
3. Metal jack plane.
4. Try square
5. Marking gauge
6. Scriber
7. Cross cut saw
8. Firmer chisel.
9. Bevelled edge chisel.
10. Hammer

RAW MATERIAL REQUIRED:

Wooden block as per the given dimension – 2 pieces.

JOB FIGURE:



PROCEDURE:

- The given wooden pieces are checked to ensure their correct size.
- The piece is firmly clamped in the carpenter's vice and any two adjacent faces are planned by the jack plane and the two faces are checked for squareness with the try square.
- Marking gauge is set and lines are drawn to mark the thickness and width of the model.
- The excess material is first chiselled out with firmer chisel and then planned to correct size from the mortise part.
- The mating dimensions of the parts are then marked using scale and marking gauge.
- Using the cross-cut saw, the portions to be removed are cut in the tenon piece, followed by chiselling and also the parts are separated by cross-cutting, using the tenon saw.
- The ends of both the parts are chiselled to the exact lengths.
- A fine finishing is given to the parts, if required, so that proper fitting is obtained.
- The parts are fitted to obtain a slightly tight joint.

PRECAUTIONS:

1. While fixing the job in the vice it should be fixed parallel to the jaws.
2. Uniform pressure should be applied while sawing
3. While cutting with saw, hold it be perpendicular to the job.
4. Chiselling is to be done carefully.

CONCLUSION:

The Mortise and Tenon joint is thus made by following the above sequence of operations.

TURNING SECTION

INTRODUCTION:

Turning is the machining process to bring the raw material to the required cylindrical shape and size by metal removal from the work surface. This is done by feeding a cutting tool against a rotating workpiece. This machine tool on which turning is carried out is called lathe.

A lathe is a machine tool that rotates a workpiece about an axis of rotation to perform various operations such as cutting, sanding, knurling, drilling, deformation, facing, and turning, with tools that are applied to the workpiece to create an object with symmetry about that axis

WORKING PRINCIPLE:

The lathe is a machine tool which holds the workpiece between two rigid and strong supports called centers or in a chuck or face plate which revolves. The cutting tool is rigidly held and supported in a tool post which is fed against the revolving work. The normal cutting operations are performed with the cutting tool fed either parallel or at right angles to the axis of the work.

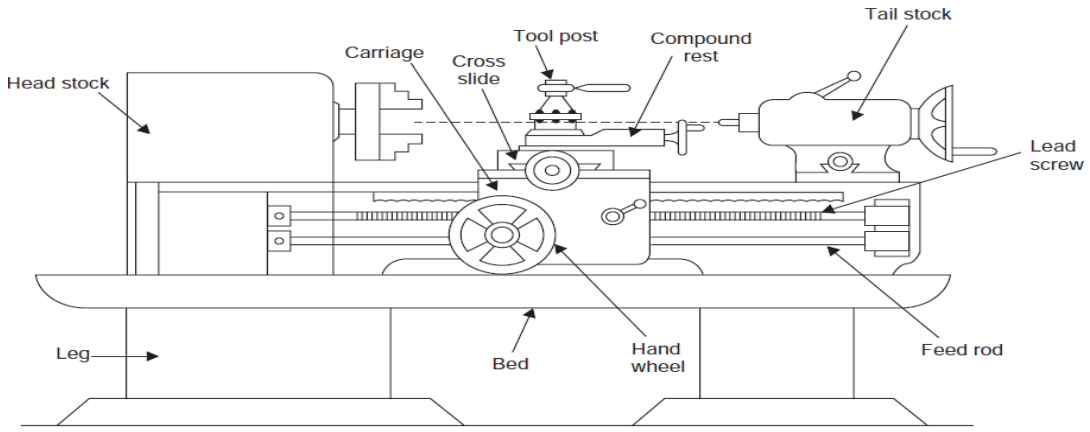


Fig. 4.1. Centre Lathe

Lathe removes considerable materials from rotating workpiece in the form of chips with the help of tools, which is feed against the rotating workpiece. The tool material should be harder than the workpiece.

TYPES OF LATHE:

Lathe machines used in workshops can be divided into following types such as Centre, Production, Engine and Special Lathe.

CENTRE LATHE: The Centre Lathe is also known as SS and SC Lathe, which is used for surface and screw body. Various types of lathe machines are available under this type i.e., Hand Lathe, Bench Lathe, Foot Lathe, Tool and Engine Lathe.

PRODUCTION LÁTHE:

Production Lathes are used when a particular job is to be produced in a large quantity. There are three kinds of production lathe machines such as Capstan Lathe, Turret Lathe and Multi Spindle Lathe.

SPECIAL LATHE:

Special types of lathe machines are used for specific purposes. For example: Relieving Lathe, which are used are providing relief to milling cutters or tap. There are three types of lathe available under this section such as : Axial turning Lathe. Copying Lathe and Relieving Lathe.

ENGINE LATHE:

Engine Lathe machines were normally used by fitters in the workshop when electric motors were not invented. These machines are operated with steam engines.

MAIN PARTS OF THE LATHE:

The following are the main parts of the lathe such as :

a. Head stock b. Tail Stock c. Carriage

d. Cross Slide e. Compound Slide f. Bed

g. Feed Shaft h. Legs i. Lead screw

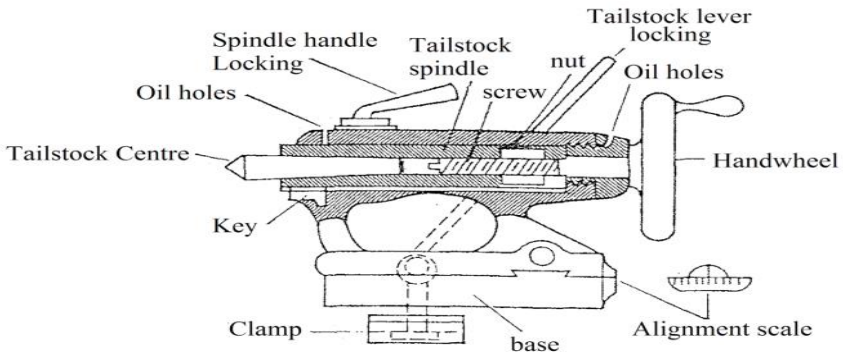
j. Quick Change Gear Box

HEAD STOCK:

It is otherwise known as Live Centre. Head stock is fitted on the lathe bed on the left hand side of the lathe operator. The required gear and cone pulley is fitted in it for driving the lathe spindle. There are two types of head stock such as : All geared and Cone pulley head stock.

TAIL STOCK:

The tail stock is otherwise known as Dead Centre. It is fitted on the lathe machines bed, on the right hand side of the lathe operator. It can be moved to any desired space on the lathe bed in case of need. It is used for centre to centre turning of lengthy workpiece.



Tailstock

Fig. 4.3.

CARRIAGE:

Literal meaning of "carriage" is to carry. Through carriage, a job can be brought in contact with the cutting tool or withdrawn from such a contact. It operates on bed ways between tail stock and head stock.

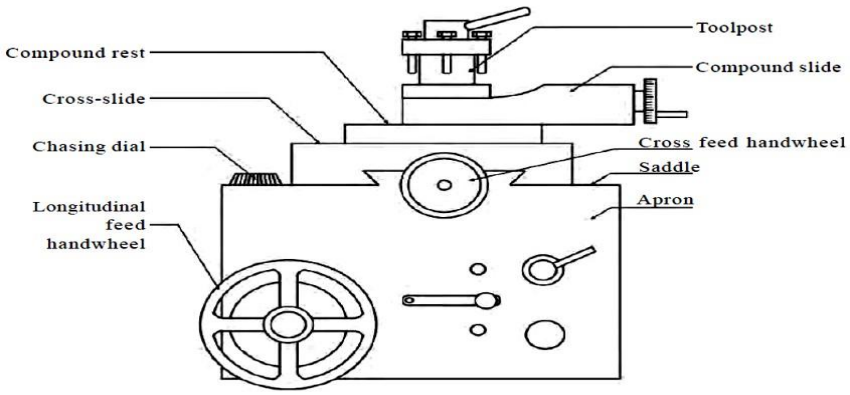


Fig. 4.4. Carriage

CROSS SLIDE:

Cross Slide Provides the cutting motion of the tool. Cross Slide can be operated by hand or by the cross feed equipment. The alignment of the cross slide is perpendicular to the center of the lathe.

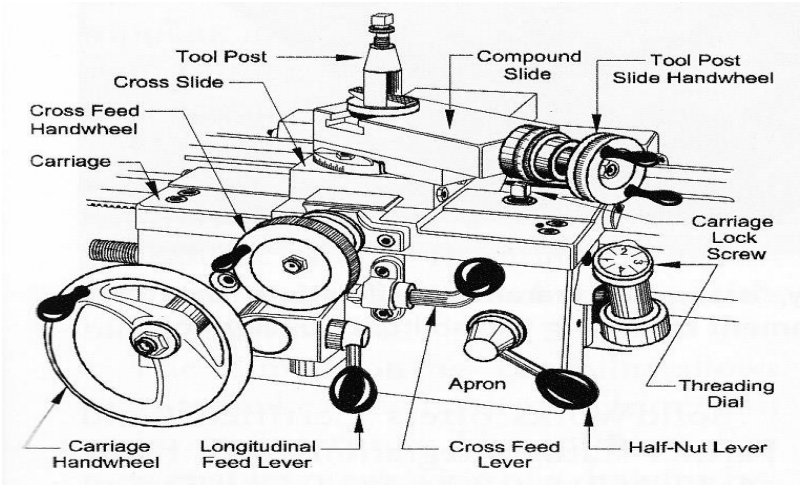


Fig. 4.5. Cross Slide

COMPOUND SLIDE :

It supports the tool post and cutting tools in its various positions. It may be swivelled on the cross slide to any angle in the horizontal planes, as it is being graduated suitably. It is necessary in turning.

Fig. 4.6. Compound Slide

BED: All the parts of the lathe machine are fixed to the bed. The saddles of the carriage slide on the beds. There are three types of beds such as : 'V' Bed, Flat Bed and Combination Bed.

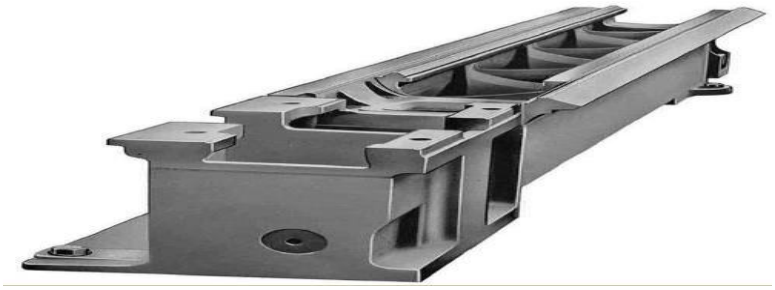


Fig. 4.7. Bed

LEAD SCREW :

It is a part of lathe machine, which is used for thread cutting operation. It has acme thread having angle 29º.

Fig. 4.8. Lead Screw

LATHE ACCESSORIES:

a. Lathe centre (Live Centre and Dead Centre)

b. Chuck

c. Catch Plated.

d. Carriage

e. Face Plate

f. Steady Rest Mandrels

LATHE CENTRE:

Centres are used to provide support to lengthy jobs on lathe machines,. These are used by fitting them into tail stock's spindle and head stock's spindle. These can be divided into two parts such as : Live Centre and Dead Centre.

Fig. 4.9. Lathe Centre

LIVE CENTRE:

These are fitted in head stock's spindles. These are driven with the power of the machine.

Fig. 4.10. Live Centre

DEAD CENTRE:

These centres are fitted in centre tail stock spindle and they provide support to the other end of the job.

Fig. 4.11. Dead Centre

CHUCK:

Chuck is normally used to provide a strong grip to catch the job on the lathe machine. These are easily fitted on the threading to the end of head stock spindle. Generally these are two types such as : Three Jaw and Four Jaw Chuck.

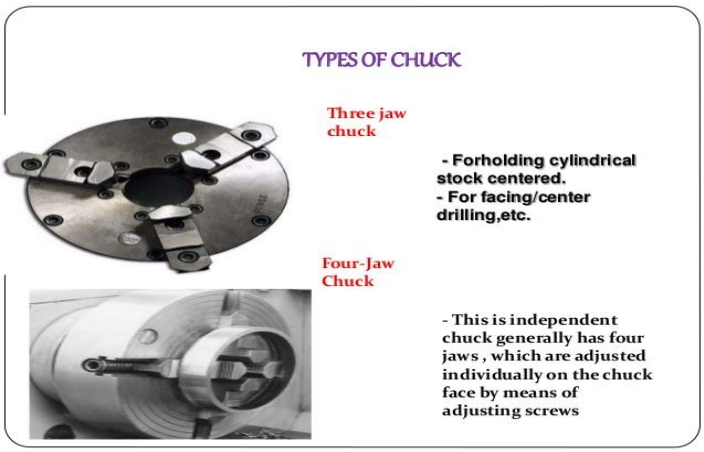


Fig. 4.12. Chuck

CATCH PLATE:

The catch plate is also known as driving plate. It is a round ordinary plate of castiron. Grooves facing each other are cut in this plate. Bent tail type job carrier is put in it and job is revolved. Threads exist in its centre and with their help head is fixed in the spindle.

Fig. 4.13.Catch Plate

CARRIERS:

The carriers are also known as Dog. It is used with the catch plate. The job is tied in the carrier and fitted in the catch plate.

Fig. 4.14.Carriers

FACE PLATE:

There are a number of jobs of such that these can not be fitted into the centres or clamped with the help of chucks for the purpose of turning. Such jobs are gripped by the face plate. This plate is also like the catch plate but it has a number of grooves on it.

Fig. 4.15.Face Plate

ANGLE PLATE.

a) An angle plate is simply a cast iron plate with to faces planed at right angles to each other and having slots in various positions for the clamping bolts.

b) It. is always used with the face plate for holding such parts which cannot be clamped against the vertical surface of the face plate.

STEADY REST :

Steady rest is used for such cylindrically long jobs which are likely to get resilient at the time of turning. These are of two types such as: Fixed Steady Rest and Travelling Steady Rest.

Fig. 4.16.Steady Rest

MANDRELS :

a) The lathe mandrel is a cylindrical bar with centre hole at each end. It is used to hold hollow work pieces to machine their external surface.

b) The work revolves with the mandrel which is mounted between the centres of the lathe. The various types of mandrels used for different classes of work are shown in Fig 4.17.

Fig. 4.17. Mandrels

LATHE OPERATIONS :

a. Facing b. Parallel turning c. Step turning d. Counter turning e. Form turning

f. Chamfering g. Cutoff h. Threading i. Boring j. Drilling k. Knurling

FACING

The act of making equal and plain ends of a job in their actual length is called facing. Facing operation is carried out before any other operations are done on the job.

PARALLEL TURNING :

Under the parallel turning, turning is done on the entire length of the job according to its maximum diameter.

STEP TURNING :

To make smaller diameter on a plain round shaft than the diameter of the shaft is called step turning. Step turning is done after the facing and parallel turning operations.

TAPER TURNING:

When one side of a job with parallel diameter, is cut turned completely or partially, to reduced its diameter, lathe operation is called taper turning. The angle of the taper is made according to the need, more or less internal or outer.

CONTOUR TURNING:

In this operation of lathe machine the tool is not fed in a straight path. Instead the tool follows a contour. A contoured form is created in the turned part.

FORM TURNING:

In this method a special shaped tool is used . The tool is inserted radially.

CHAMFERING :

Tapering of a small part of a job at its edge or corner is known as chamfering: Chamfering is done after boring, knurling etc.

CUT OFF OR PARTING:

In parting operation the tool is fed radially and the end part of the workpiece is cut off.

THREAD TURNING :

In the workshops where there is need for cutting tapers frequently, taper turning is used. This attachment is fixed behind the carriage.

BORING:

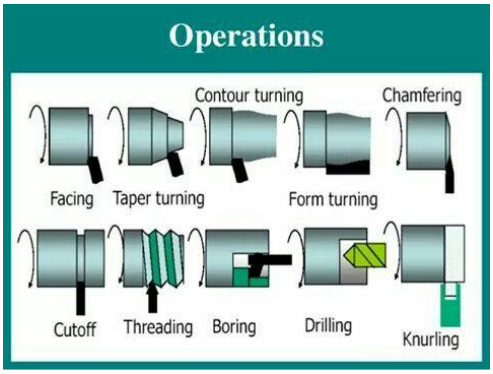
A single point tool head is fed linearly to the end of the workpiece (on the inside diameter) .

DRILLING

Drilling and reaming is done by feeding the lathe tool along the axis of the rotating job part

KNURLING:

Drawing slanting or square projecting lines on the surface of a job in order to have better grip is known as knurling. For this purpose a special knurling tool is used.



JOB NO. 03

AIM OF THE EXPERIMENT:

To prepare different types of Job Operation By S.S and S.C. Lathe

OBJECTIVES OF THE EXPERIMENT :

a. To know and identify the sliding surfacing and screw cutting (SS and SC) lathe machine.

b.To know and identify the main parts of the SS and SC lathe machine.

c. To know main functions of the different parts of the lathe machine.

d. To know different operations such as facing, cantering, plain turning, step turning taper turning and grooving etc.

TOOLS AND EQUIPMENT REQUIRED

SERIAL NO	NAME OF EQUIPMENT	SPECIFICATION / TYPE	QUANTITY
01	Facing Tool		
02	Grooving Tool		
03	Tapering Tool		
04	Revolving Centre/Dead Centre		
05	Threading Tool		

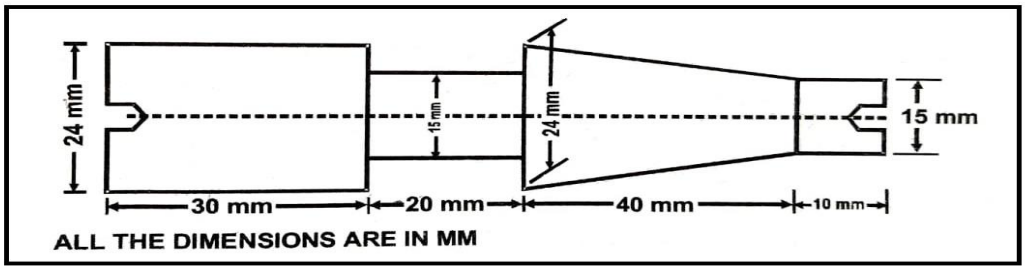
MEASURING INSTRUMENT :

a. Slide caliper **b.** Outside Caliper **c.** Steel Rule

RAW MATERIAL REQUIRED :

M.S Round Rod **: As per specified Given Job Diagram.**

JOB FIGURE :



PROCEDURE :

1. At first study the drawing from the blackboard carefully.
2. Then cut the metal by the help of power hacksaw according to given specification.
3. Then hold the job by the help of chuck
4. Then facing the job by the facing tool.
5. Then drill centre hole is mounted on the tail stock.
6. Set the job between chuck and tail stock.
7. Make parallel turning according to the required diameter.
8. Then grooving the job according to the required dimension.
9. Make step turning.
10. Then tapering the job by the tapering tool.
11. Make threading according to the given pitch with proper adjustment in the feed gear box of the machine.
12. Then finished the job according to the required dimension.

OBSERVATION :

Tolerance : +0.25mm.

	DESIRED DIMENSION IN mm	ACTUAL DIMENSION IN mm	DEVIATION FROM ALLOWABLE TOLERANCE	REASONS FOR DEVIATION
Maximum Dia of Taper				
Minimum Dia of Taper				
Groove Dia				
Length of the Job				

CONCLUSION :

Explain the reasons for deviation from the given specification of the finished job. Suggest methods for improvement of quality of the job.

ASSIGNMENT QUESTIONS

1. Draw the job sketch.
2. Is it possible to hold the job with the help of chuck?
3. Write down the different types of chuck?
4. What do you mean by taper?
5. Write down the different types of taper?

6. What is the difference between hollow spindle and solid spindle?
7. What is the difference between live centre and dead centre?
8. What is the difference between revolving centre and dead centre?
9. What is the difference between Universal chuck and Independent chuck?
10. What are the different angles on lathe cutting tools?
11. What are the jobs that can be done on a lathe machine?
12. What is meant by speed, cutting speed and feed?