A Laboratory manual

For

MECHANICAL WORKSHOP 2 (PR- 3)

S.C.T.E & V.T, Odisha

Semester – 4TH

DEPARTMENT OF MECHANICAL ENGINEERING

GOVERNMENT POLYTECHNIC, SAMBALPUR

EXPERIMENT NO. : 01

AIM OF THE EXPERIMENT

Study of different types of Carpentry tools and their uses

APPARATUS (CARPENTRY TOOLS)REQUIRED:

Sl .No	NAME OF THE ITEAMS/TOOLS	SPECIFICATION	QUANTITY
01	RULES	600mm	01
02	TRY SQUARE	200mm	01
03	Bevel square	200mm	01
04	Marking knife	150mm	01
05	Trammel	300mm	01
06	Spirit level	200mm	01
07	Cross cut saw	600-650mm	01
08	Tennon or back saw	250-400mm	01
09	Key hole saw	250mm	01
10	Firmer chisel	125mm	01
11	Beveled edge firmer chisel	25mm	01
12	Mortise chisel	15mm	01
13	Jack plane	200mm	01
14	Smooth plane	150mm	01
15	Bradawl and gimlet	200mm	01
16	C - clamp	150mm	01

THEORY

01. RULES:-

Rules of various sizes and designs are used by carpenter for measuring and setting out of dimensions, but they usually work with a four-fold box-wood rule ranging from 0 to 60cm.

02. TRY SQUARE:-

Try square is used for marking and testing angles of 90degree. It consists of a steel blade, riveted into a hard wood stock.

03. BEVEL SQUARE:-

The bevel square is similar to the try square but has a blade that may be swiveled to any angel ranging from 0degree to 180 degree. This tool is adjusted by releasing with turn screw of suitable size in a machine screw running in slot in the blade.

04. MARKING KNIFE:-

Marking knifes are used for converting the pencil line into cut line.They are made ofsteel having one end pointed and the other end formed into a sharp cutting edge.

05.TRAMMEL:-

The trammel is a form of beam compass with a wooden beam to carry out work that cannot be done by a compass.

06.SPIRIT LEVEL:-

These are used for testing the position of large surfaces. The spirit level tests forhorizontal position.

07.CROSS-CUT SAW

Cross-cut saw or "hand saws" as they are sometimes called, are used for cutting across the grain in thick wood . These are600 to 650mm long with 8 to 10 teeth per 25mm gap. The action of the teeth is that of a series of knives which sever the fibers and force out the waste wood in the form of saw dust.

08.TENNON SAW:-

This saw is mostly used for cross cutting when a finer and more accurate finish is required . The blade being very thin is reinforced with a rigid steel back. Tennon saw blades are from 250 to 400mm in length and generally have 13 teeth per 25mm. The teeth are shaped in the form of an equilateral triangle and are sometimes termed "peg" teeth.

09.PAD OR KEYHOLE SAW:-

This is the joiners smallest saw theblade being about 250mmlong. The blade of thepad saw is secured to the, throw which is passes by two screws. This arrangement allows the blade to be adjust to the best length required according to the work this saw is used for cutting key holes or the starting of the any interior cuts.

10.FIRMERCHISEL:-

The firmer chisel is the most useful for general purposes and may be used by hand pressure or mallet . It has a flat blade about 125mm long.The width of the blade varies from 1.5 to 50mm.

11.BEVELED EDGE FIRMER CHISEL:-

The bevel edge firmer chisel is used for more delicate or fine work. They are useful for getting into corners where the ordinary firmer chisel clumsy .

12.MORTISE CHISEL:-

The mortise chisel is usedfor chopping out mortise. These chiselsare designed to withstand heavy work .

13.JACK PLANE:-

A jack plane is the commonest and is used for the first truing up of a piece of wood . It consists of a block of wood into which the blade is fixed by a wooden wedge, the blade is placed at an angle of 45 degree to the sole . On the cutting blade, another blade is fixed called cap iron or back iron. This does not cut, but stiffens the blade near its cutting edge to prevent chattering and partially breaks the shaving as it is made. It is the back iron which causes the shavings to be curled when they come out of the plane. Jack planes are obtainable from 350mm to425mm in length and with blades 50mm to 75mm wide.

14.SMOOTHING PLANE:-

The plane is similar in action to a jack plane, except that it is set to cut a much thinner shaving. A smoothing plane, as its name indicates is used for smoothing or finishing after a jack plane.

15.BRADAWL AND GIMLET:-

The bradawl and the gimlet are hand-operated tools. These are used to bore small holes, such as for starting a screw or large nail.

16.C-CLAMP:-

The c-clamp is used for smaller work. It consists of a malleable iron frame that can be swivel led and a steel screw to which is fitted a thumb screw.

CONCLUSION

Hence we studied successfully about carpentry tools, know their operation and uses.

EXPERIMENT NO. : 02

AIM OF THE EXPERIMENT

To make a different carpentryoperations such as sawing, planning, chiseling.

APPARATUS REQUIRED

SL.NO	NAME OF THE ITEAMS	SPECIFICATION	QUANTITY
01	Tennon saw	300mm	01
02	Jack plane	200mm	01
03	Mortise chisel	15mm	01
04	Steel rule	600mm	01
05	Marking knife	150mm	01

Raw materials Required-Wood of size (50x35x259)

THEORY

01. SAWING:-

- To do sawing operation fit the wood piece of required dimension in the carpenter vice.
- Then mark the dimensions to be cut by marking knife.
- Then cut the job along the marking line with the help of tennon saw.

02.PLANNING:-

- After cutting to set the required dimension and also to obtain finishing we have to do planning operation.
- To do this operation fit the job by the planning devise “jack plane”.
- While planning it should be careful so that jackplane removes proper chips and makes the wood surface to be fine.

03.CHISELING:-

- Chiseling is done to remove extra material from the job and also produces male and female part of a joint.
- To do chiseling operation put the edge of the mortise chisel on the marking line to be cut.
- Then by the help of hammer strike the chisel along the marking line and complete the chiseling operation.

04.MEASURING AND MARKING:-

- Measuring is generally done by steel rule to set correct dimension.
- After measuring and marking is done by “marking knife” for getting permanent line for cutting operation.

CONCLUSION

Hence we do different carpentry operation successfully.

EXPERIMENT NO. : 03

AIM OF THE EXPERIMENT

Study of different types of timbers used by carpenters,substitutions by timbers.

THEORY

Timber is the name given to the wood obtained from wellgrown (Matured)trees. The trees are cut down into various sizes to suit building or other carpentry/ wooden Furniture purpose.

MARKET SIZES OF TIMBER:-

1. **Log** – The trunk of the tree, which is free from branches.
2. **Balk** – The log, sawn to have roughly square cross section.
3. **Post** – A timber piece round or square in cross-section having its diameter on side, varying from 175mm to 300mm.
4. **Plank** – A sawn timber piece, with more than 275mm in width, 50mm to 150mm in thickness and 2.5 to 6.5 meters in length.
5. **Board** – A sawn timber piece, be low 50mm thickness and more than 125mm in width.
6. **Batten** – Asawn timber piece, below 175mm in width and 30mm to 50mm in thickness.

CLASSIFICATION OF TIMBER:-

Timbers are generally classified into two types.They are

- Soft timber
- Hard timber

Soft timbers are obtained from conifers, Kari, ash, deodar, and sumac.

Hard timbers are obtained from Sal, teak, oak, ash, mango and babul.

CHARACTERISTIC OF GOOD TIMBER:-

- It should have minimum moisture contain.
- The grain of wood should be straight and long.
- It should be free from crack.
- It should be uniform color.
- It should produce near metallic sound on hammering.

CONCLUSION:

Hence we know regarding different types of timbers used by carpenters.

EXPERIMENT NO. : 04

AIM OF THE EXPERIMENT:- Cutting of slot, notch, mortise and tennon joint.

TOOLS AND EQUIPMENTS REQUIRED

SL.NO	NAME OF THE ITEAMS	SPECIFICATION	QUANTITY
01	Carpenter's vice	600mm	01
02	Steel rule	300mm	01
03	Jack plane	250mm	01
04	Try square	150mm	01
05	Marking gauge	150mm	01
06	Firmer chisel	25mm	01
07	Mortise chisel	15mm	01
08	Cross-cut saw	350mm	01
09	Tennon saw	300mm	01
10	Scriber	150mm	01
11	Mallet	250mm	01

RAW MATERIAL SIZE REQUIRED

Wood size = (50×35×259)mm

PROCEDURE

- The given raw material is checked to ensure its correct size.
- The wood is firmly clamped in the carpenter's vice and one of It's faces are planed by the jack plane and checked for straightness.
- The adjacent faces are then planed and the faces are checked for squareness with the try square.
- Marking gauge is set and lines are drawn at 30 and 45mm to mark the thickness and width of the model respectively.
- The excess material is first chiseled out with the firmer chisel and then planed to correct size.
- The mating dimensions of the parts – X and Y are then marked using the scale and marking gauge.
- Using the cross cut saw the portions to be removed in part –Y (tenon) is cut, followed by chiseling.
- The material to be removed in part –X (mortise) is carried out by using the mortise and firmer chisels.
- The parts X and Y are separated by cross – cutting with the tenon saw.
- The ends of both the parts are chiseled to exact lengths.
- Finish chiseling is done wherever needed so that ,the parts can be fitted to obtain a tight joint.

CONCLUSION :- The mortise and tennon joint is thus made by following the above sequence of operations.

EXPERIMENT NO-05

AIM OF THE EXPERIMENT

To prepare a singledovetail joint.

APPARATUS REQUIRED

Sl No	NAME OF THE ITEMS	SPECIFICATION	QUANTITY
01	Carpenter's vice	600mm	01
02	Steel rule	300mm	01
03	Jack plane	200mm	01
04	Try square	150mm	01
05	Marking gauge	150mm	01
06	Firmer chisel	25mm	01
07	Cross cut saw	350mm	01
08	Tenon saw	150mm	01
09	Scriber		01
10	Mallet(wood)	250gm	01

RAW MATERIAL REQUIRED

Wood size required – $(50\times35\times250)mm^3$

PROCEDURE

- The given material is checked to ensure its correct size.
- The material 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 at 30 and 45mm to mark the thickness and width of the model respectively .
- The excess material is first chiseled out with the firmer chisel and then planned to correct size.
- The matching dimensions of the parts X and Y 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 chiseling and also the parts X and Y are separated by cross cutting using the tenon saw
- The ends of both the parts are chiseled to exact lengths .
- A fine finishing is given to the parts , if required so that proper fitting is obtained .
- The parts are fitted to obtained a slightly tight joint.

CONCLUSION

The single dovetail joint is thus made by following the above sequence of operations.

EXPERIMENT NO. : 06

AIM OF THE EXPERIMENT

To study of S.C. Lathe and their accessories practice in lathe work.

APPARATUS REQUIRED

Sl No	NAME OF THE ITEMS	SPECIFICATION	QUANTITY
01	Lathe (SC)	4^{ii}	01
02			01

THEORY

INTRODUCTION :

A lathe is used to cut and shape the metal by revolving the work against a cutting tool. The work/job is clamped either in a chuck, fitted into the lathe spindle or in between the centers. The cutting tool is fixed in a tool post, mounted on a movable carriage i.e. positioned on the lathe bed. The cutting tool can be fed into the work, either length wise or cross wise. While turning, the chuck rotates in counter clock wise direction, when viewed from the tail stock end.

PRINCIPAL PARTS OF A LATHE:-

01 . HEAD STOCK :

It contains either a cone pulley or gearing to provide the necessary range of speeds and feeds. It contains the main spindles, to which the work is held and rotates.

02 . TAIL STOCK:

It is used to support the right hand end of a long work piece. It may be clamped in any position along the lathe bed. Drills, reamers, taps may also be fitted into the spindles for performing operations such as drilling, reaming and tapping.

03 . LATHE BED :

It is an essential part of a lathe, which must be strong and rigid. It carries all part of the machine and resists the cutting force. The carriage and the tail stock move along the guide ways provided on the bed.

04 .CARRIAGE:

It is used to control the movement of the cutting tool. The carriage assembly consists of the longitudinal slide, cross slide and the compound slide and apron.

05 . COMPOUND REST :

It supports the tool post. By swiveling the compound rest on the cross slide, short tappers may be turned into any desired angle.

06 . TOOL POST :

The tool post holds the tool holder on the tool, which may be adjusted to any working position.

07. LEAD SCREW:

It is a long threaded shaft, located in front of the carriage, running from geared to the spindle and controls the movement of the tool, either for automatic feeding or for cutting threads.

Accessories:

Lathe accessories are used for (i) Holding & supporting the work

(ii) Holding the tool.

Examples of Lathe accessories are

(i)	Centers	(v)	Steady Rest
(ii)	Chucks	(vi)	Follow Rest
(iii)	Face plate	(vii)	Lathe Dog
(iv)	Mandrel	(viii)	Drill Holder

CONCLUSION

Thus we have successfully studied about the various parts of the S.C lathe.

EXPERIMENT NO. : 07

AIM OF THE EXPERIMENT

To prepare plain turning and step turning.

APPARATUS REQUIRED

SL.NO	NAME OF THE ITEAMS	SPECIFICATION	QUANTITY
01	Chuck key		01
02	Steel rule	300mm	01
03	Vernier caliper	200mm	01
04	Surface gauge	200mm	01
05	Box spanner	10 mm	01
06	Cutting tool	H.S.S – 4”	01

RAW MATERIAL REQUIRED:-

M.S. Rod 35×100m

PROCEDURE

Fit the job in the chuck of the lathe with the help of chuck key.

- Fit the cutting tool on the tool post.
- Test the job whether it is perfectly fixed or not by surface gauge)
- Now start the machine and do plane turning by giving small feed to the cutting tools by moving the hand wheel of the carriage.
- When the entire length of the work piece is turned, then start step turning.

- The step turning is done on the required length of the job as per sketch. The step turning diameter is also given in the sketch.
- Step turning is done by giving more cross feed movement to the cutting tool as per diameter required.
- Repeat the above step till the required step diameter does reach.
- Measure the accurate diameter by using a venire caliper and then finish/complete the step turning.

CONCLUSION

Finally we obtain a job with required shape and dimension by the help of plain turning and step turning.

EXPERIMENT NO. : 08

AIM OF THE EXPERIMENT:

To prepare tapper turning and knurling.

APPARATUS REQUIRED

SL.NO	NAME OF THE ITEAMS	SPECIFICATION	QUANTITY
01	Chuck key		01
02	Steel rule	300mm	01
03	Venire caliper	300mm	01
04	D. spanner	14 – 15 mm	01
05	Cutting tool	H.S.S. – 1"×4"	01
06	Box Spanner	10mm	01
07	Surface Gauge	300mm	01

RAW MATERIAL REQUIRED

M.S Road 35mmX100mm.

PROCEDURE

- Properly fit the job in the chuck of the lathe machine.
- Perform plane turning operation on entire length of the job up to dia. 35mm.
- Then leave 30mm from left and do step turning operation on 20mm length till the dia reach 30mm.
- Now remove cutting tool and fit the knurling tool in the tool post .
- Do knurling operation as per sketch by knurling tool.
- Then remove knurling tool and enter cutting tool.
- Then tapper turning is done on 30mm length as shown in the sketch.
- Tapper turning is done by setting the compound slide at an angle calculated above that is angle $\Theta=15^0$ and moving compound slide along length of tapper.
- Formula Used-

  Taper Formula = $\Theta = \tan^{-1}(\frac{D-d}{2l})$

  Where D= Larger diameter = 30mm

  d= Smaller diameter = 15mm

  l= Length of tapper = 30mm

So, $\Theta = \tan^{-1}(\frac{30-15}{2X30}) = 14^0 2' \cong 15^0$

CONCLUSION

Finally we obtain the required shape and size of the job by tapper turning and knurling operation.

EXPERIMENT NO. : 09

AIM OF THE EXPERIMENT:

To prepare external threading.

APPARATUS REQUIRED

SL.NO	NAME OF THE ITEAMS	SPECIFICATION	QUANTITY
01	Chuck key		01
02	Steel rule	300mm	01
03	Venire caliper	300mm	01
04	D. spanner	14 – 15 mm	01
05	Cutting tool	H.S.S. – 1”×4”	01

Raw Material Required:

M.S. Rod of Dia. 35 mm of Length 100 mm. for a single job

PROCEDURE

- Fit the job on the lathe machine chuck.
- Do plain turning and step turning as per sketch.
- Set the compound slide at 45 degree and do chamfering by the chamfer tool on the required dimension as per sketch.
- Then set the gear box for external threading and connect the carriage with the lead screw.
- Then start the external threading operation on the required length as shown in figure.

CONCLUSION

Finally the external threading operation is done on the job by following the above procedure.