# GOVERNMENT POLYTECHNIC COLLEGE

# KOOVAPPADY, PERUMBAVOOR

**DIPLOMA IN MECHANICAL ENGG**

# MACHINE SHOP PRACTICE

**SEMESTER V**

# Gptcperumbavoor

## Vision

*Excel as a centre of skill education moulding professionals who sincerely striveforthebetterment of society.*

## Mission

1. To impart state of the art knowledge and skill to the graduate and moulding them to be competent, committed and responsible for the well being of society.
2. To apply technology in the traditional skills, thereby enhancing the living standard of the community.

# DEPARTMENT OF MECHANICAL ENGINEERING

**Vision and Mission of the Department**

## VISION:

*Moulding innovative and creative diploma holders in Mechanical Engineering with capabilities to contribute for industries and society.*

**MISSION:**

To deliver professional competence by:

- Quality education for lifelong learning with emphasis on sound technical knowledge and ethics.
- Provide good infrastructure facilities so that students will gain hand on experience by using various equipment, machinery and software.
- Transform the students into a committed technical personal for the social, economic and sustainable development of the society.

# MEASURING INSTRUMENTS

Measuring instruments have an important role in a mechanical workshop. The different types of measuring instruments used in a workshop are;

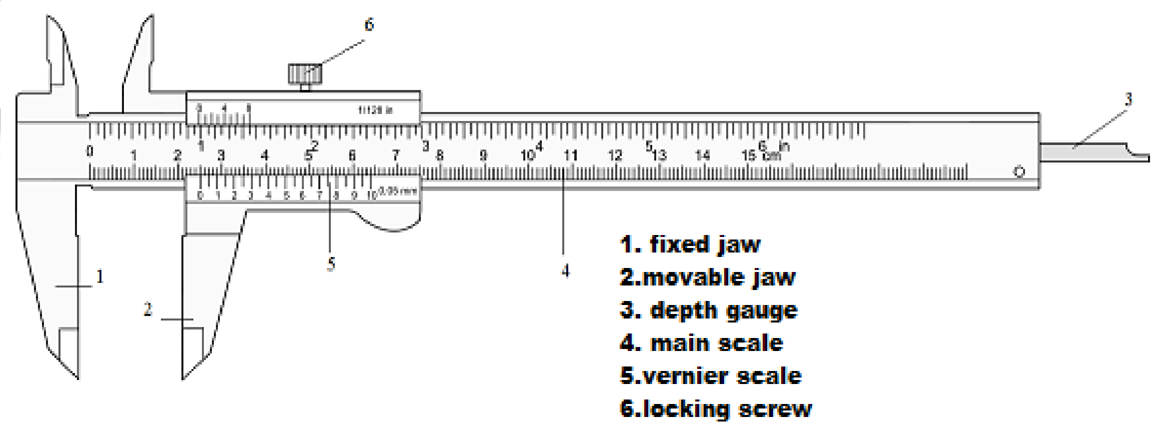
1. Steel rule 2. Calipers 3. Vernier caliper 4. Micrometer
5. Vernier height gauge 6. Screw thread pitch gauge 7. Dial test indicator
8. Screw cutting gauge etc.

**Steel rule**

Steel rule is a direct reading and measuring instrument to read at an accuracy (least count) of 0.5 mm. These are available in different sizes, such as in 15cm, 30cm, 60cm, 1m, 1.5m, 2m, 3m, 4m, 5m & 6m.

**Vernier caliper**

The Vernier caliper is a precision instrument used for measuring internal and external distances between two points with an accuracy of 0.02mm. It can also be used to measure depth.



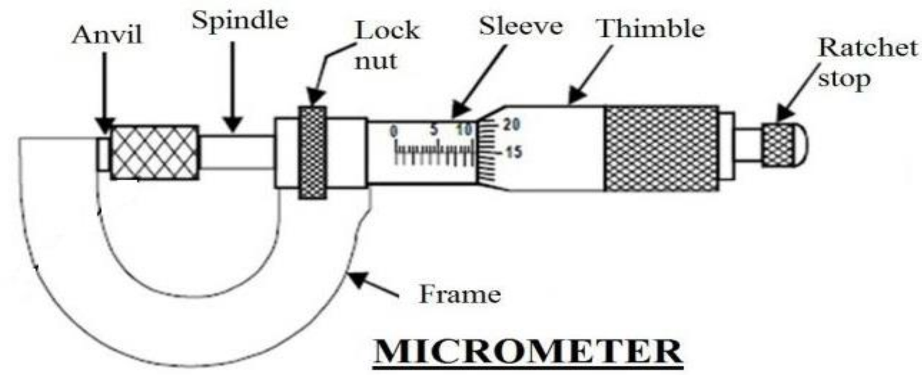

**Least count (LC):** Least Count is the smallest value that can be read directly in the scale. A Vernier Caliper has a main scale and a Vernier scale. The accuracy of vernier caliper is the difference of one division of main scale and one division of vernier scale. A vernier caliper having main scale length of 49 mm is divided into 50 divisions in vernier scale.

One main scale division = 1 mm.

One vernier scale division = 49/50 mm. = 0.98 mm.

Least count = 1- 0.98 mm = 0.02 mm.

## MICROMETER (screw gauge)




It is a precision measuring instrument used to read an accuracy of 0.01 m.m

Micrometers are in three types:

(a) Outside micrometer (b) Inside micrometer (c) Depth micrometer

They are available in the ranges of 0-25mm, 25-50mm, 50-75mm, 75-100mm, etc.

***Outside micrometer***

It is used to measure external measurements with an accuracy of 0.01 mm. The work is placed between anvil and spindle face. The working principle of micrometer is a nut and bolt. The spindles have a thread of 0.5 mm pitch which is assembled with the thimble. One revolution of thimble makes movement of 0.5 mm of spindle. The thimble is divided into 50 equal divisions.

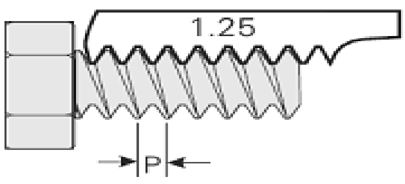
**Least count (LC) =** Pitch / Number of divisions on the main scale = 0.50mm/50= 0.01 mm

**How to take measurements**

Total observed reading = main scale reading + (circular scale division coinciding the base line of main scale) x least count

True diameter = observed diameter – zero error

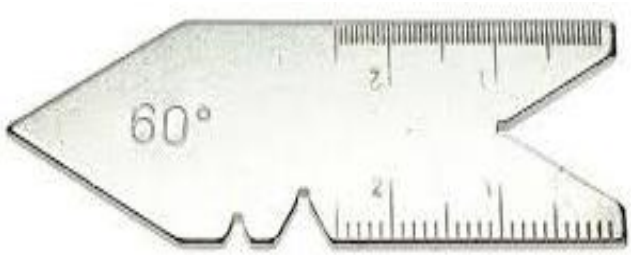
**Screw thread pitch gauge**




Checking the pitch of thread

A screw thread pitch gauge is used to check or find the pitch of a thread. It is a series of thin marked blades which have different pitched teeth.

**Screw cutting gauge (centre gauge)**



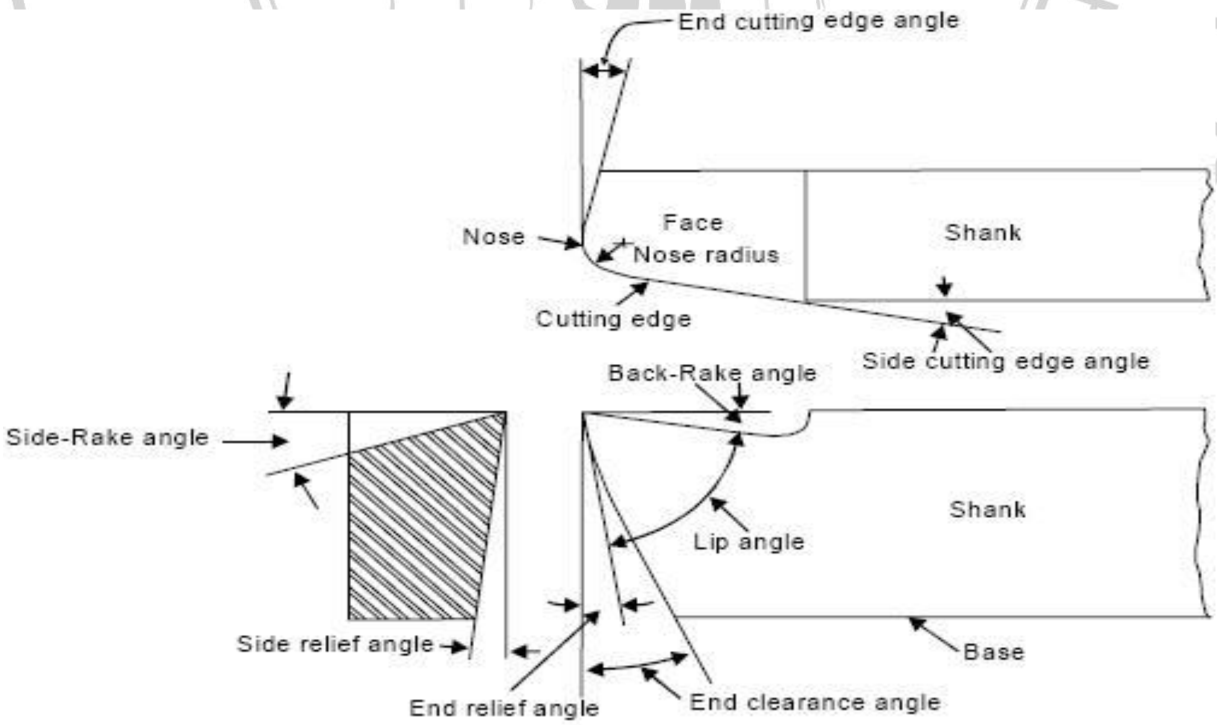

Screw cutting gauge is an important tool used in a machine shop, made from hardened and polished stainless steel. It is also known as Center gauge. It is used for checking tool angles while machining threads in metal turning lathes.

**CUTTING TOOLS**

Cutting tool is a device with one or more cutting edges used to create chips and remove metal from the work piece. Generally, cutting tools are classified as single point cutting tools and multi point cutting tools.

**Tool Signature**

It specifies the active angles of the tool normal to the cutting edge.



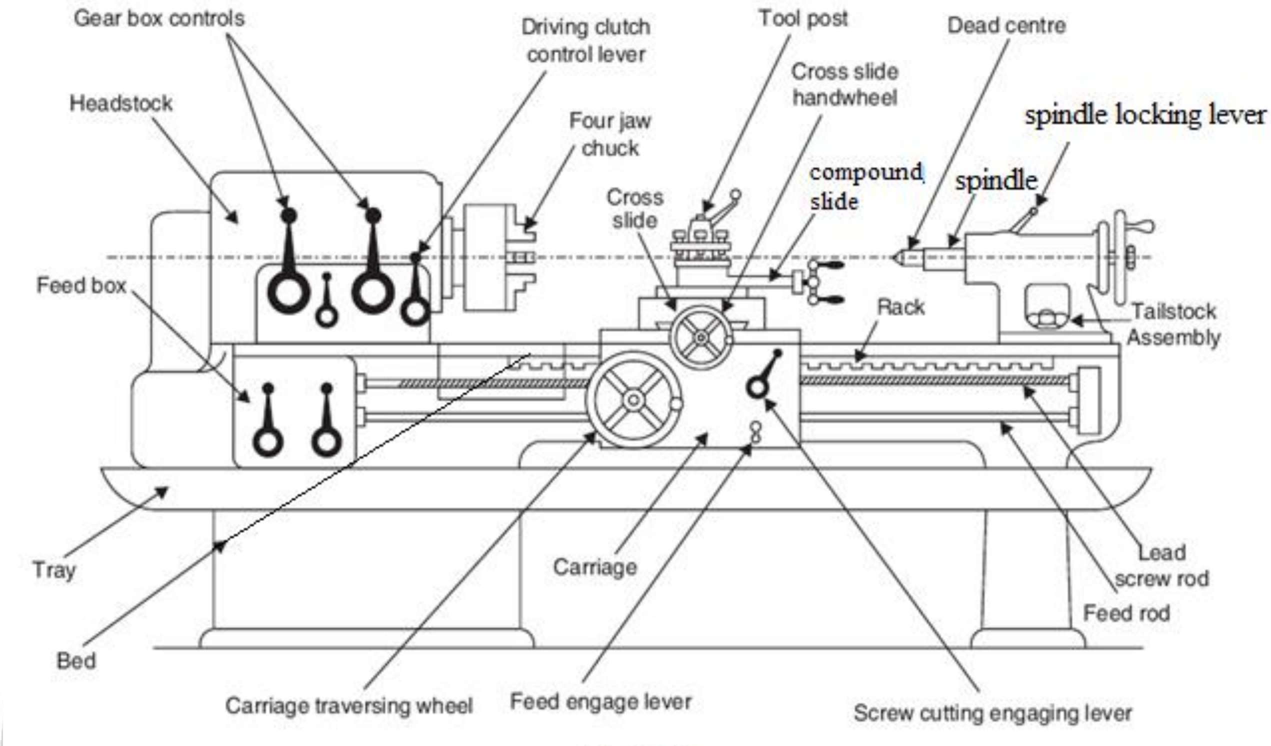
The seven elements that comprise the signature of a single point cutting tool can be stated in the following order:

| Tool signature | angles |
|---|---|
| Back rake angle (°) | 10 |
| Side rake angle (°) | 20 |
| End relief angle (°) | 7 |
| Side relief angle (°) | 6 |
| End cutting edge angle (°) | 8 |
| Side cutting edge angle (°) | 15 |
| Nose radius mm | 0.8 |

**Cutting tool materials and their uses**

| Tool material | Properties |
|---|---|
| Carbon Steels | Low cost. Used for low-grade drill bits, taps and dies, hacksaw blades, reamers. |
| High Speed Steel (HSS) | Low cost. Used for drill bits, taps, lathe cutting tools. |
| HSS Cobalt | Expensive. Excellent for machining abrasives, work hardening materials such as Titanium and Stainless steel. Used for milling cutters and drill bits. |
| Cemented Carbide | Expensive. Used for turning tool bits although it is very common in milling cutters and saw blades. |

# LATHE




Engine lathe

**Introduction**

The process of machining a work piece to the required shape and size by moving the cutting tool either parallel or perpendicular to the axis of rotation of the work piece is known as turning. In this process, excess unwanted metal is removed.

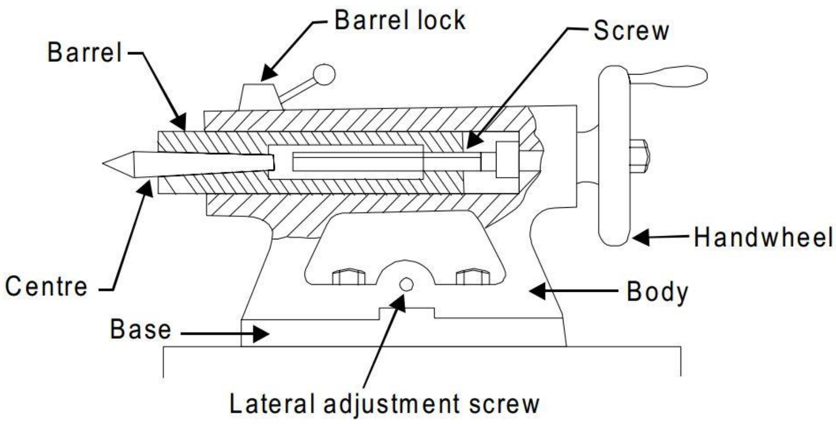
**Principal parts of an engine lathe**

**Bed**: The bed is the foundation of the lathe. It is made of cast iron.

**Head Stock**: Headstock is mounted permanently at the left hand side of the bed. The headstock houses a hollow spindle and the mechanism for driving the spindle at multiple speeds. It contains cone pulleys, v pulleys or gears to provide the necessary range of spindle speeds.

**Tail Stock**: The tailstock supports the ‘free’ end of the work. The tailstock is also used in the drilling and reaming of work held in chuck or on faceplate.

**Carriage or Saddle**: Carriage forms the base of the unit, which supports the cutting tool. Carriage can be traversed along the whole length of the bed by hand control or by power feed.




**Cross Slide**: It is mounted on the top of saddle, and it provides a mounted or automatic cross movement for the cutting tool.

**Apron**: Apron houses the control for hand or power feeding.

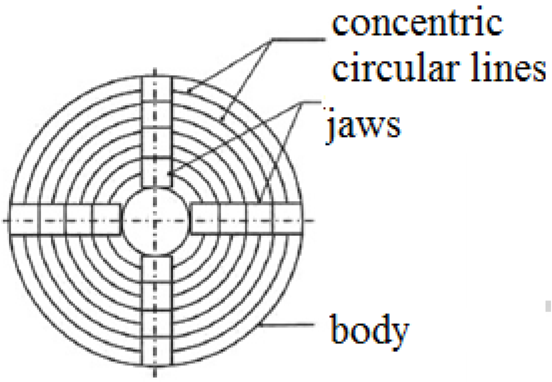
**Lead Screw:** Leadscrew transmits feed motion for screw cutting. (Acme thread)

**Feed Shaft**: Feed shaft is employed in operating the carriage or the cross slide in automatic turning.

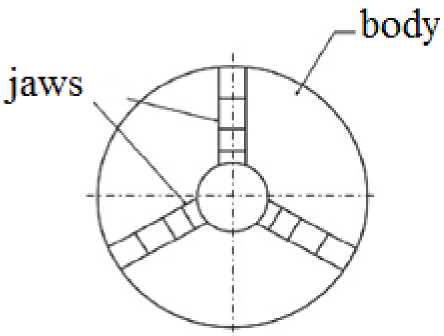
**Work holding and supporting devices**

**Chucks:** Chucks are used for holding work pieces. Different types of chucks are,

1. **3 jaw -Self centering chuck**: The three-jaw chuck is a self-centering chuck. Self-centering means that all three jaws move in or out depending on the direction of rotation of the key. Three-jaw chuck will not directly hold square material. The 3-jaw self-centering chuck will automatically centre rounds or hexagons.



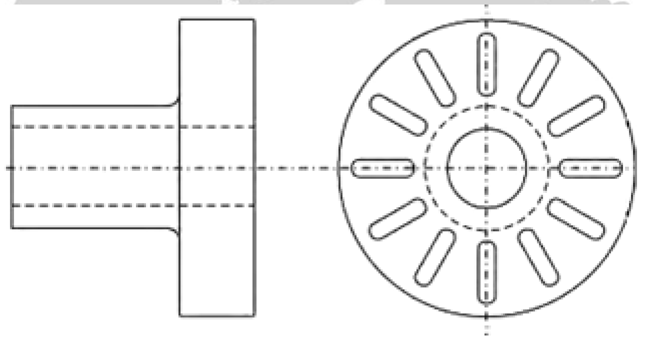

four jaw chuck




Three jaw chuck

**2. 4-jaw- independent chuck:** It is used for holding work of irregular shape. It can also be used for holding squares or rounds. All jaws are controlled independently of each other. The jaws are reversible. This allows the holding of larger work.

**Face Plate**: Faceplate is used for mounting work of awkward shapes, which cannot be chucked.

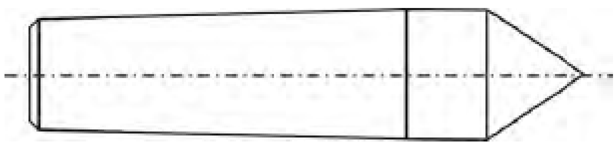


Face plate

**Lathe Centers**

Centres are useful in supporting the work in a lathe. The shank of a centre has Morse taper on it and the face is conical in shape. There are two types of centres, namely

1. Live centre 2. Dead centre



Centre

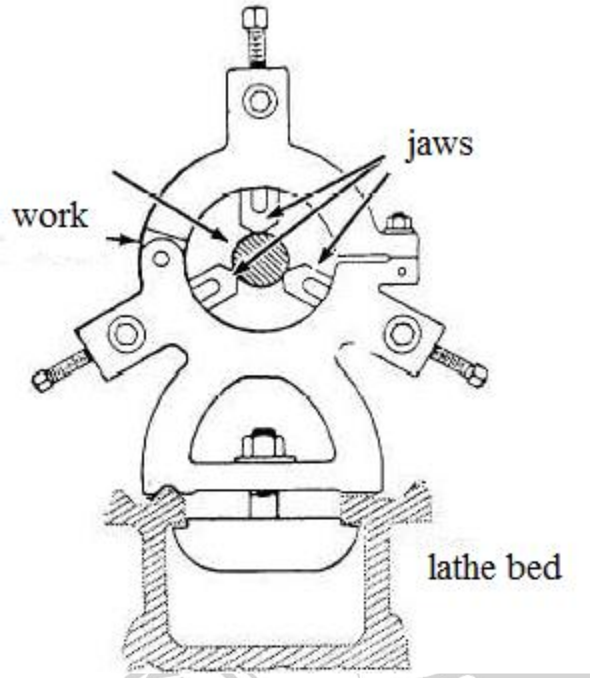
The live centre is fitted on the headstock spindle and rotates with the work. The centre fitted on the tailstock spindle is called dead centre. Centres are made of high carbon steel and hardened and then tempered. Different types of centres are available according to the shape of the work and the operation to be performed.

**Steadies**

Steadies are used for supporting long work against the pressure of the tool.

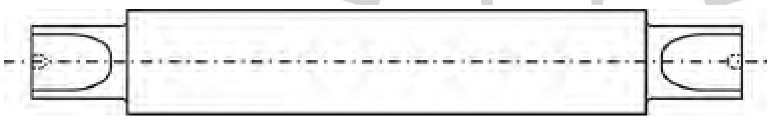
a. Fixed steady b. Travelling steady

The fixed steady is secured to the lathe bed. The travelling steady is mounted on the carriage. This steady move along the work behind the tool, as each cut is taken.




**Mandrels**

Mandrels are slightly tapered spindles. Previously bored components or part machined work can be mounted for further turning operations. Commonly used mandrels are: Plain mandrel, Step mandrel, Gang mandrel, Screwed mandrel, Collar mandrel, Cone mandrel and Expansion mandrel.



Plain mandrel

**Tool Post:** Tool posts are classified as follows

(1) Pillar Type Tool Post (2) 4-Way Tool Post

(3) Quick – Release Type Tool Post

**Lathe specifications**

1. Length of bed.
2. Length between centres.
3. Swing diameter over carriage.
4. Spindle nose diameter.
5. Swing diameter over bed.
6. Centre height.
7. Bore diameter of the spindle.

**Lathe operations**

The most common operations performed on a lathe are turning, facing, parting, grooving, knurling, drilling, boring, taper turning and threading.

**Facing**: It is to produce a flat surface normal to the rotational axis of the spindle.

**Plain Turning**: It is to remove excess material from the work-piece and to produce a cylindrical surface.

**Parting**: Parting or cutting–off is the operation of separating a piece of initial work from the bar-stock.

**Drilling**: It is an operation of producing cylindrical hole by means of a cutting tool i.e., drill.

**Grooving or necking**: Grooving is the operation of reducing the diameter of work-piece to a narrow surface.

**Boring**: It is the operation of enlarging a hole previously made by drilling.

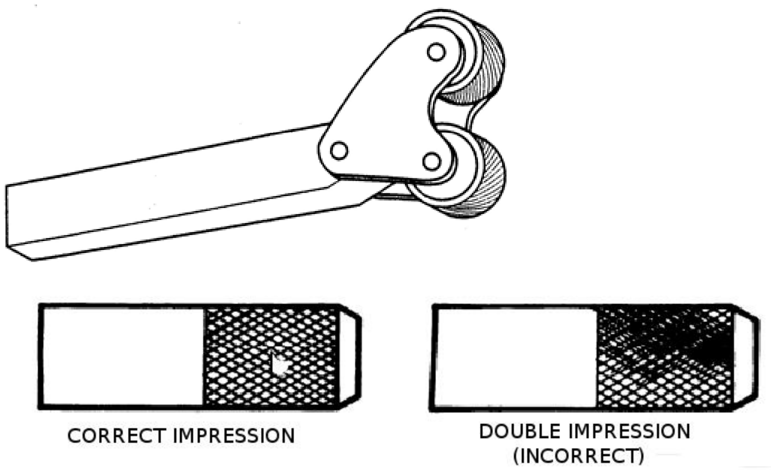
**Taper:** A taper may be defined as a uniform increase or decrease in diameter of a piece of work measured along its length.

**Taper turning methods**

1. Form tool method
2. Compound rest method
3. Tailstock set over method
3. Taper turning attachment method

**Reaming:** Reaming is the process of finishing a drilled or bored hole with great degree of accuracy. The drilled or bored hole is not always straight or accurate.

**Knurling:** It is the process of making easy-to-grip geometric pattern on a finished outer surface of work pieces like handles, knobs, rollers, etc, to hold them firmly.



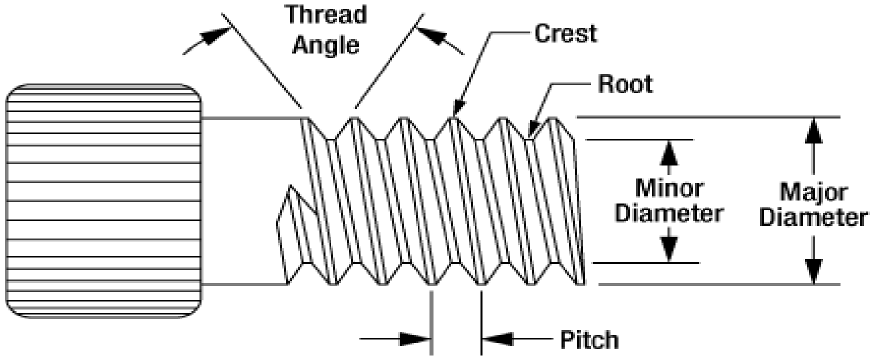

**Forming:** It is a process of producing a convex, concave or any irregular profile on the work piece by using a form tool.

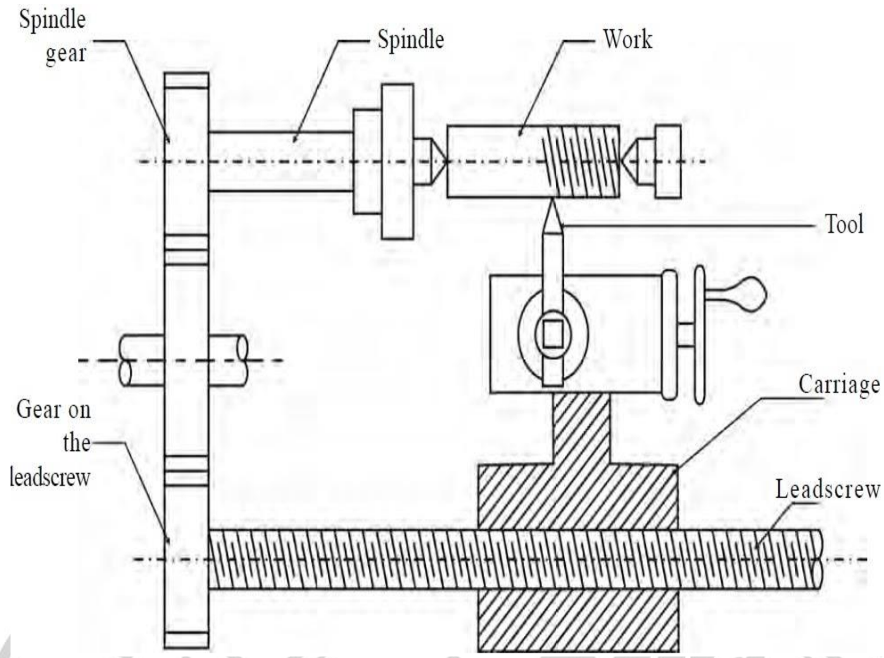
**Chamfering**: Itis a process of beveling the extreme end of a work piece. This is done to remove the burrs and sharp edges from the extreme end of the work piece.

**Thread cutting**

The process of thread cutting is to produce a helical groove on a cylindrical surface by feeding the tool longitudinally. The job is revolved between centers or by a chuck. The longitudinal feed should be equal to the pitch of the thread to be cut per revolution of the work piece.

**THREAD PARTS**






In thread cutting operation the first step is to remove the excess material from the work piece to make its diameter equal to the major diameter of the thread to be cut. The shape or form of the thread depends on the shape of the cutting tool to be used. The tool point must be ground so that it has the same angle as the thread to be cut. In a metric thread the included angle of the cutting edge should be ground exactly 60°. Typical angles are 60° for 'V' threads, and 29° for acme threads. The top of the nose of the tool should be set at the same height as the centre of the work piece.

The correct gear ratio is required between the machine spindle and the lead screw. This can be determined in the following manner:

**Thread cutting calculations:**

To calculate the gears required for cutting a thread of certain pitch can have calculated from the following formula:

$$\frac{\text{Driver teeth}}{\text{Driven teeth}} = \frac{\text{Speed of the leadscrew}}{\text{Speed of the spindle}} = \frac{\text{Pitch of the screw to be cut}}{\text{Pitch of the lead screw}}$$

The gear of the spindle shaft is the driver and the gear on the lead screw is the driven gear.

# SHAPING MACHINE (SHAPER)

Shaping is a process of machining a flat surface which may be horizontal, vertical, inclined, concave or convex using a reciprocating single point tool. A shaping machine is a reciprocating type of machine tool.

**Common types of shaper**

Shapers are classified in many ways, i.e. According to the length of the stroke, type of driving mechanism, direction of travel of the ram, the type of work etc. The different types of shapers are,

1. Crank shaper 2. Horizontal shaper 3. Universal shaper 4. Vertical shaper

**Principal parts of a shaper**

**Base:** The base is hollow and is made of cast iron. It provides the necessary support for all other parts of the machine.

**Column:** It is a box like casting mounted vertically on top of the base. It is mounted on the front vertical guide ways of the column. The table may be raised or lowered by adjusting the cross rail vertically.

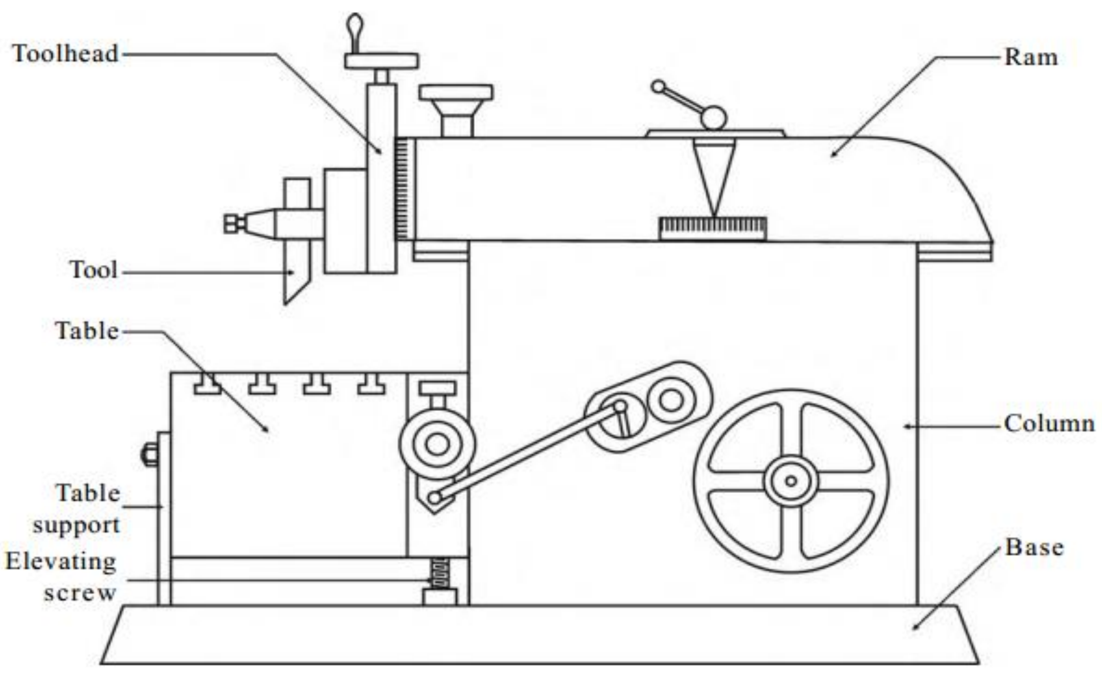


**Table:** It is an important part useful in holding the work firmly on it. It is mounted on the saddle which is located above the cross rail. Work pieces are held on the table with the help of shaper vice, clamps and straps.

**Ram:** It supports the tool head on its front. It reciprocates on the accurately machined guide ways on the top of the column.

**Tool head:** It is fitted on the face of the ram and holds the tool rigidly. It provides vertical and angular feed movement of the tool.

**Shaper operations**

A shaper is a machine tool primarily designed to generate a flat surface by a single point cutting tool. Besides this, it may also be used to perform many other operations. They are,

1. Machining horizontal surface 2. Machining inclined surface

3. Machining vertical surface 4. Key ways cutting 5. Slot cutting

**Shaper specifications: -**The size of a shaper is determined by the maximum length of cut or stroke it can make. Complete specification of a shaper include,

1. Length of stroke
2. Maximum horizontal travel of table
3. Maximum vertical travel of table
4. Maximum distance from table to ram
5. Maximum vertical travel of tool slide
6. Length and width of table top

**Work holding devices**

1. Shaper vise 2. Clamps and stop pins 3. T- bolts & step bolts

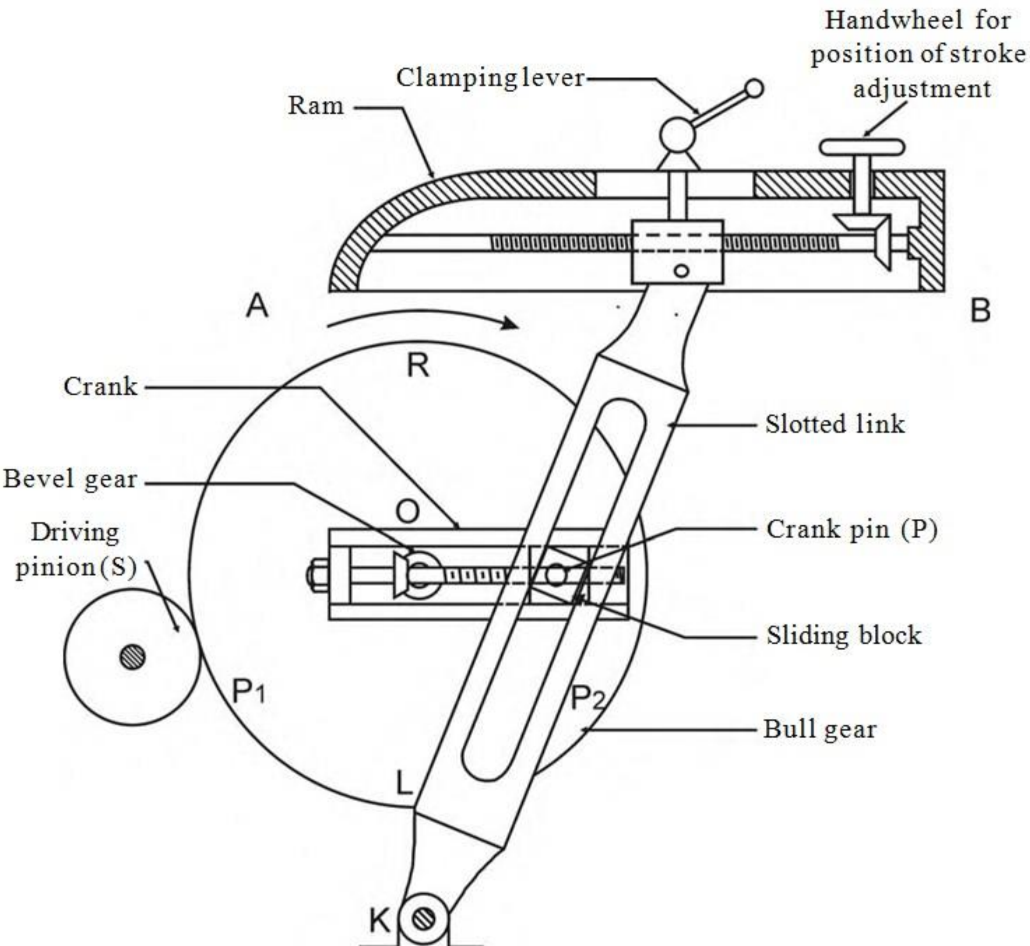
4. Angle plate 5. V block

**Cutting Tools materials used in a shaping machine**

1. High Carbon Steel 2. High Speed Steel 3. Carbide tipped tool 4. Stellite tool

**Quick return mechanisms**

The ram moves at a comparatively slower speed during the forward cutting stroke. During the return stroke, the mechanism is so designed to make the tool move at a faster rate to reduce the idle return time. This mechanism is known as quick return mechanism.



Crank and Slotted Link Mechanism

**Stroke length calculation and adjustment**

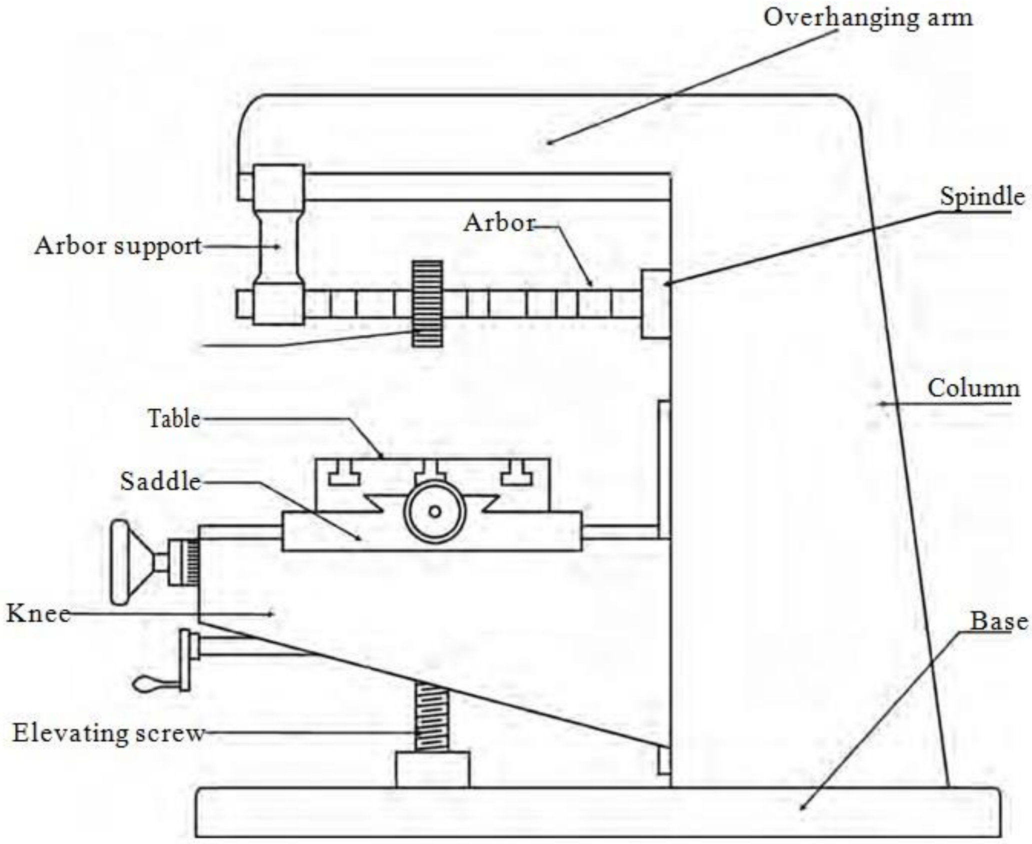
The length of the stroke is calculated to be nearly 30mm longer than the work. The position of stroke is so adjusted that the tool starts to move from a distance of 25mm before the beginning of the cut and continues to move 5mm after the end of the cut.

## MILLING MACHINE

**Introduction**

A milling machine is a machine tool that removes metal as the work is fed against a rotating multipoint cutter. The milling cutter rotates at high speed and it removes metal at a very fast rate with the help of multiple cutting edges. One or more number of cutters can be mounted simultaneously on the arbor of milling machine.

Milling machine is used for machining flat surfaces, contoured surfaces, surfaces of revolution, external and internal threads, and helical surfaces of various cross-sections.




Horizontal Milling Machine

**Common types of milling machines**

1. Column and knee type milling machines
   a) Horizontal milling machine
   b) Universal milling machine
   c) Vertical milling machine
2. Planer milling machine
3. Machining center machines
4. Special types of milling machines

(a) Rotary table milling machine. (b) Duplicating machine.

**Principles of milling**

In milling machine, the metal is cut by means of a rotating cutter having multiple cutting edges. For cutting operation, the work piece is fed against the rotary cutter. As the work piece moves against the cutting edges of milling cutter, metal is removed in the form of chips.

1. **Base: -**It is a foundation member and it carries the column at its one end. In some machines, the base is hollow and serves as a reservoir for cutting fluid.

2. **Column: -**The column is the main supporting member mounted vertically on the base. It is box shaped, heavily ribbed inside and houses all the driving mechanism for the spindle and table feed.

3. **Knee: -**The knee is a rigid grey iron casting which slides up and down on the vertical ways of the column face. An elevating screw mounted on the base is used to adjust the height of the knee and it is also support the knee.

4. **Saddle: -**The saddle is placed on the top of the knee and it slides on guide ways set exactly at 90° to the column face. The top of the saddle provides guide-ways for the table.

5. **Table:** The table rests on ways on the saddle and travels longitudinally. A lead screw under the table engages a nut on the saddle to move the table horizontally by hand or power. In universal machines, the table may also be swiveled horizontally. For this purpose, the table is mounted on a circular base.

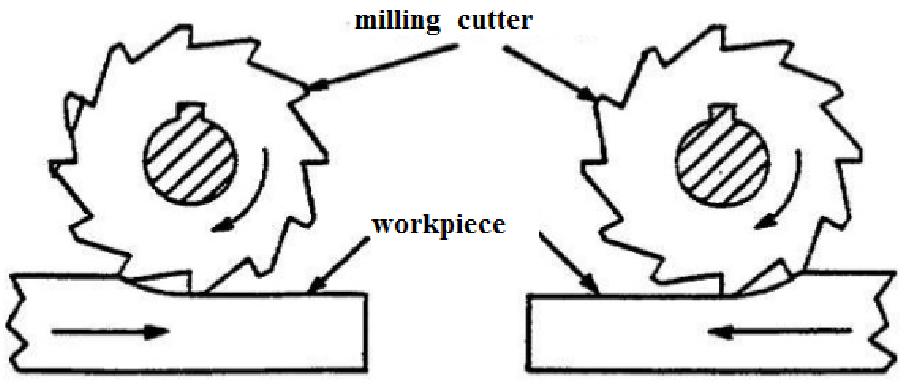
**6. Overhanging arm:** It is mounted on the top of the column, which extends beyond the column face and serves as a bearing support for the other end of the arbor.

7. **Front brace: -**It is an extra support, which is fitted between the knee and the over-arm to ensure further rigidity to the arbor and the knee.

8. **Spindle: -**It is situated in the upper part of the column and receives power from the motor through belts, gears and clutches and transmit it to the arbor.

9. **Arbor: -**It is like an extension of the machine spindle on which milling cutters are securely mounted and rotated. The arbors are made with taper shanks for proper alignment with the machine spindles having taper holes at their nose

**Milling methods: -**There are two distinct methods of milling classified as follows:




**Up-milling or conventional milling**

In the up-milling or conventional milling, the metal is removed in form of small chips by a cutter rotating against the direction of travel of the work piece. In this type of milling, the chip thickness is minimum at the start of the cut and maximum at the end of cut.

**Down-milling or climb milling:** In this method, the metal is removed by a cutter rotating in the same direction of feed of the work piece. Chip thickness is maximum at the start of the cut and minimum in the end. In this method, there is less friction involved and consequently less heat is generated on the contact surface of the cutter and work piece.

**Various milling machine operations**

Following different operations can be performed on a milling machine:

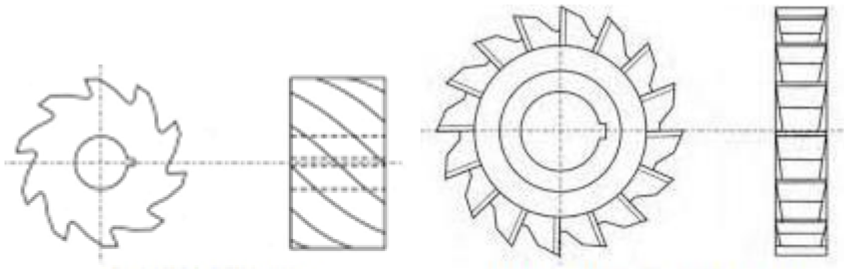
1. Plain milling operation
2. Face milling operation
3. End milling operation
4. Gear cutting operation
5. Side milling operation
6. Angular milling operation
7. Thread milling operation

**Types of milling cutters**

Milling cutters are made in various forms to perform certain classes of work, and they may be classified as:

1. Plain milling cutter 2. Side milling cutter

3. Face milling cutter 4. End milling cutter



PLAIN MILLING CUTTER SIDE MILLING CUTTER

Depending upon the shape of their shank, these are,

1. **Taper Shank Mill:** Taper shank mill have tapered shank.
2. **Straight Shank Mill:** Straight shank mill have straight shank.
3. **Shell End Mills:** These are normally used for face milling operation.
4. **Formed cutters**
    1. **Convex Milling Cutters:** These cutters have profile outwards at their circumference and used to generate concave semicircular surface on the work piece.
    2. **Concave Milling Cutters:** These milling cutters have teeth profile curve inward on their circumference. These are used to generate convex semicircular surfaces.

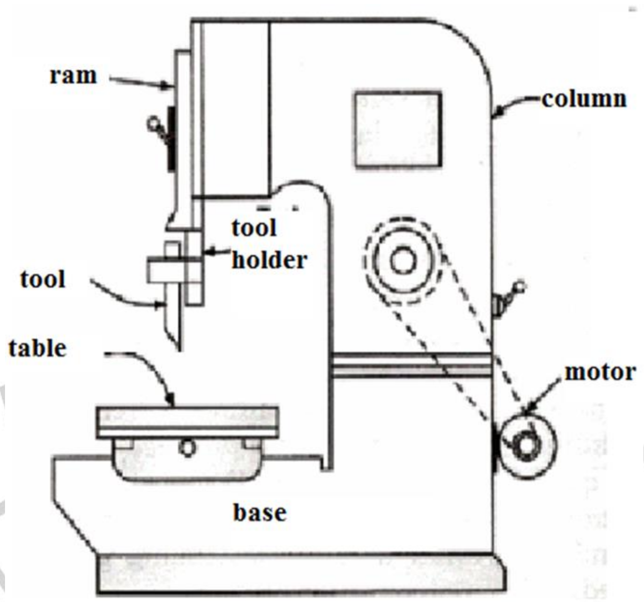
**<u>Specification of a milling machine</u>.**

1. Size of the worktable and its movement.
2. Table movements:- (Longitudinal travel x Cross x Vertical).
3. Number of feeds available (specify their values).
4. Number of spindle speeds (specify their values).
5. Total power available.
6. Spindle nose taper.

# SLOTTING MACHINE

**Introduction**

The slotter or slotting machine is also a reciprocating type of machine tool similar to a shaper. It may be considered as a vertical shaper.




**Common types of slotting machine**

1. Puncher slotting machine.
2. General production slotting machine.
3. Precision tool room slotting machine.

**Uses of slotting machines**

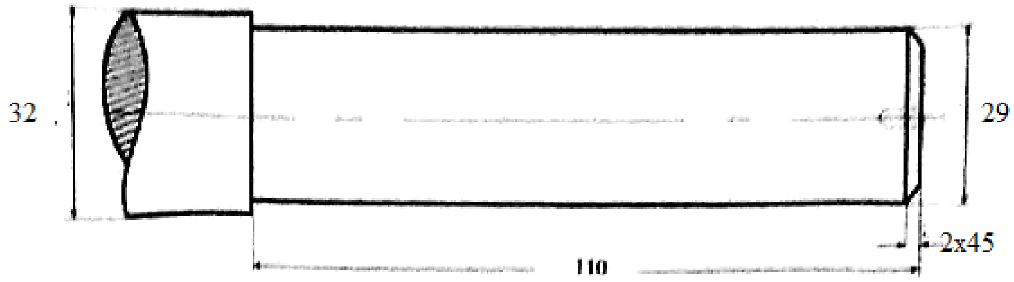
1. It is used for machining vertical surfaces.
2. It is used angular or inclined surfaces.
3. It is used to cut slots, splines, keyways for both internal and external jobs such as machining internal and external gears.
4. It is used for works involving machining concave, circular, semi-circular and convex surfaces.

**Slotting machine operations**

Operations which can be performed on the slotting machine are, cutting of:

1. Internal grooves or key ways.
2. Internal gears.
3. Recesses.
4. Concave, circular and convex surfaces etc.

**EX.NO 1 PLAIN TURNING**




All dimensions are in mm

Ex. No 1

Date:

## PLAIN TURNING

**1. Aim:**

Plain turning and chamfering operations of mild steel round rod.

**2. Material required:**

M S round rod of ø ____mm, length ____ mm.

**3. Tools required:**

HSS single point cutting tool, chuck key, tool post key, vernier caliper, steel rule and jenny caliper.

**5. Operations required:**

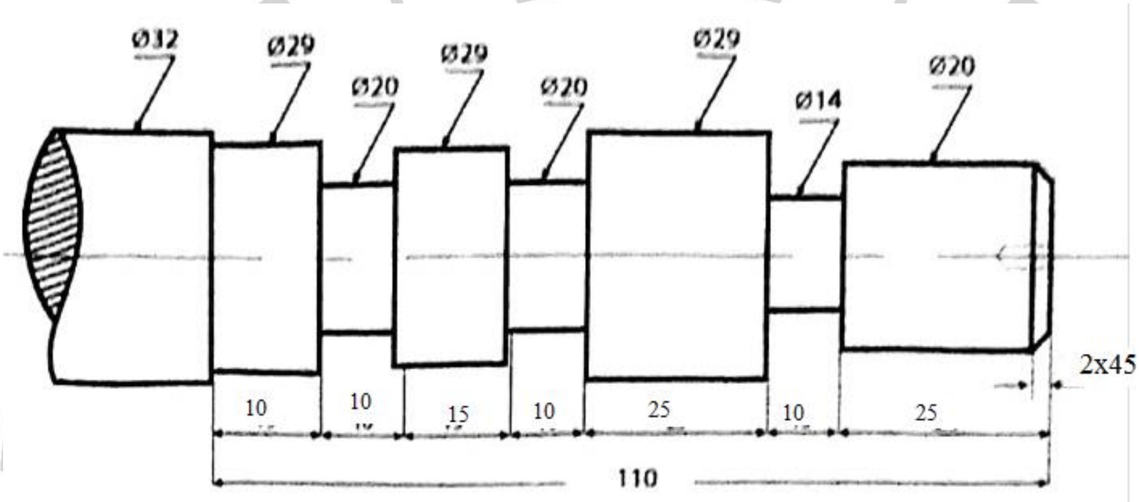
Work setting, facing, centering, plain turning, chamfering.

**6. Procedure:**

- The work piece is fixed in a chuck with sufficient overhang.
- Adjust the machine to run the job to a required cutting speed.
- Fix the cutting tool in the tool post
- Facing operation is performed from the center of the job to outwards or from the circumference towards the center.
- Centering operation is performed so that the axis of the job coincides with the lathe axis.
- Re-fix the work with tail stock support.
- Give the feed and depth of cut to the cutting tool
- Plain turning operation is performed until the diameter of the work piece reduces to_____ mm and length _____mm.
- Finished the job as per correct dimensions
- Finally checked the dimensions by using vernier caliper and submitted for inspection

**Result:** Completed Plain turning as per dimensions

## Ex.No. 2 - Step turning and Collar turning




All dimensions are in mm

Ex no:2

Date:

## Step turning and Collar turning

**Aim:**

To practice step turning and collar turning

**Material required:**

M S round rod of ø ____mm, length ____ mm.

**Tools required:**

HSS Single point cutting tool, parting tool, chuck key, tool post key, vernier caliper, steel rule, jenny caliper,

**Operations required:**

Work setting, facing, centering, plain turning, step turning, grooving, Chamfering, knurling

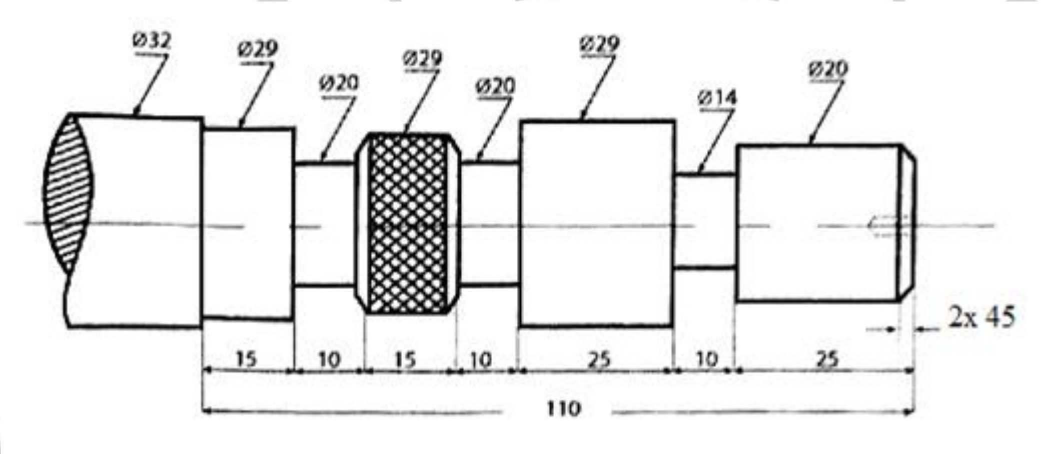
**Procedure:**

- The work piece is fixed in a 3-jaw chuck with sufficient overhang.
- Adjust the machine to run the job to a required cutting speed.
- Fix the cutting tool in the tool post.
- After facing and centering operation is performed, re-fix the work with tail stock support.
- Give the feed and depth of cut to the cutting tool
- Plain turning operation is performed until the diameter of the work piece reduces to ____mm and length ____mm.
- Performed step turning and collar turning as per dimensions of given drawing.
- Using parting tool, grooving operation is performed according to the given dimensions.
- Finished the job and checked all dimensions by using vernier caliper.

**Result**: Completed Step turning and Collar turning as per drawing

Ex no:3

KNURLING PRACTICE




All dimensions are in mm

Ex no:3

Date:

# KNURLING PRACTICE

**Aim:**

To practice Knurling operation.

**Material required:**

M S round rod of ø ____mm, length ____ mm.

**Tools required:**

HSS. Single point cutting tool, parting tool, chuck key, tool post key, vernier caliper, steel rule, jenny caliper, knurling cutter

**Operations required:**

Work setting, facing, centering, plain turning, step turning, grooving chamfering, knurling

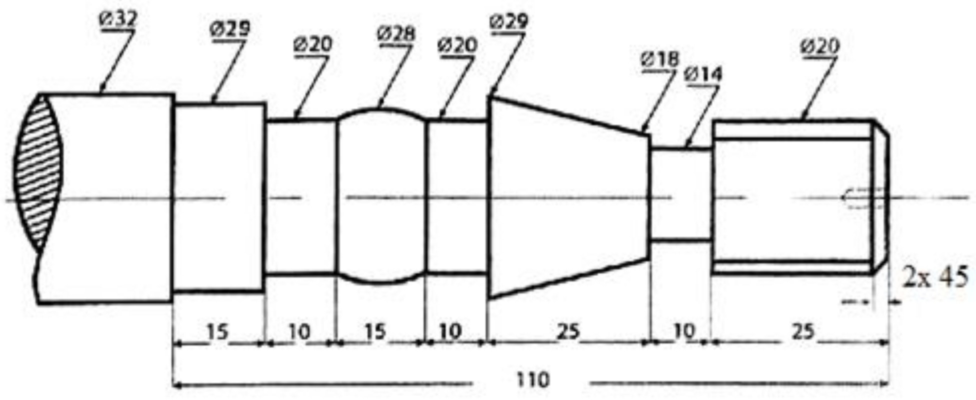
**Procedure:**

- The work piece is fixed in a chuck with sufficient overhang.
- Adjust the machine to run the job to a required cutting speed.
- Fix the cutting tool in the tool post.
- After facing and centering operation is performed and re-fix the work with tail stock support.
- Give the feed and depth of cut to the cutting tool
- Plain turning operation is performed until the diameter of the work piece reduces to ____mm and length ____mm.
- Completed step turning and collar turning as per dimensions of given drawing.
- Using parting tool, grooving operation is performed according to the given dimensions.
- Fixed knurling tool on lathe center and performed knurling operation.
- Finished the job and checked all dimensions by using vernier caliper.

**Result:** Completed the job as per drawing.

EX.NO 4

**Form turning, taper turning and thread cutting**




All dimensions are in mm

Ex no:4

Date:

## Form turning, taper turning and thread cutting

**Aim:**

To practice form turning, taper turning and thread cutting

**Material required:**

M S round rod of ø ____mm, length ____ mm.

**Tools required:**

HSS. Single point cutting tool, parting tool, threading tool, chuck key, tool post key, vernier caliper, steel rule and jenny caliper,

**Operations required:**

Work setting, facing, centering, plain turning, step turning, grooving, taper turning, chamfering, threading, form turning.

**Procedure:**

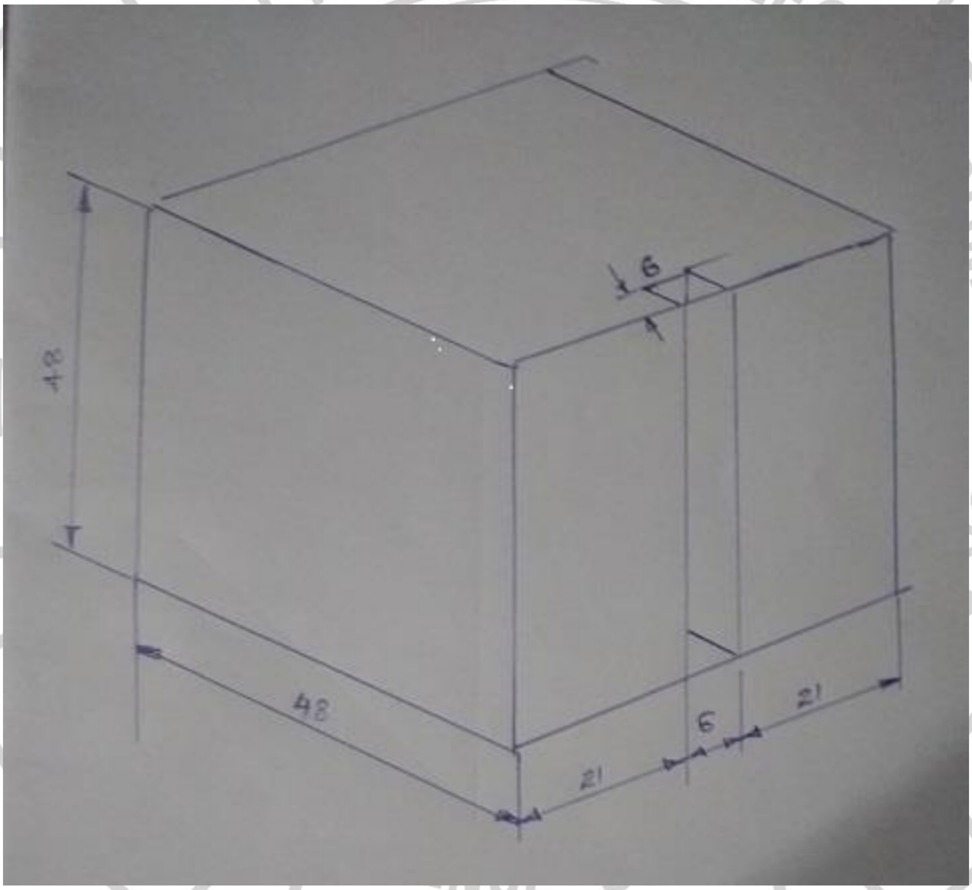
- The work piece is fixed in a 3-jaw chuck with sufficient overhang.
- Adjust the machine to run the job to a required cutting speed.
- Fix the cutting tool in the tool post.
- After facing and centering operation is performed, re-fix the work with tail stock support.
- Give the feed and depth of cut to the cutting tool
- Plain turning operation is performed until the diameter of the work piece reduces to ____mm and length ____mm.
- Completed step turning and collar turning as per dimensions of given drawing.
- Using parting tool, grooving operation is performed according to the given dimensions and finish the grooves
- Swivelled the compound slide to the required angle and completed taper turning operation by rotating the compound slide wheel. The angle can be calculated by using the formula,

$$\tan\alpha = \frac{D - d}{2L}$$

- Fixed the v tool or forming tool on tool post and formed ball by the movement of carriage and cross slide.
- Reduced speed of the spindle by engaging back gear and used tumbler feed reversing mechanism to transmit power through the lead screw.
- Calculated the change gears for the required pitch to be made on the work piece.
- Using half nut mechanism performed thread cutting operation (right hand threading) according to the given dimensions and continued it until required depth of cut is obtained.
- Checked the depth of thread using thread pitch gauge
- Finished the work and checked all dimensions

**Result: -** Completed the job as per dimensions.

**Ex.No.5. Key way / Slot cutting**



Ex no:5

Date:

## KEY WAY / SLOT CUTTING

**Aim:** To make a slot on a given cast iron blank

**Material required**: Cast iron block of 48 x 48 x 48mm

**Operations to be carried out**: marking, punching, job setting, slotting

**Tools required**: surface plate, spanner, single point cutting tool,

Square nose tool, Vernier height gauge, ballpeen hammer, dot punch etc.

**Procedure:**

- Set the single point HSS tool on tool holder
- Adjust the length of stroke of ram
- Square blank is prepared to the required dimension on slotting machine.
- Marking is carried out on the work piece for slotting.
- Set the square nose tool for slotting operation.
- Slotting machine is operated to perform the necessary cutting action and complete the model as per the required dimension.

**Result:** The model is prepared as per the sketch