Lathe Machine is one of the oldest machine tools in the production machine. This Machine is also known as the “mother of all machines“.

Today we will study Definition, Parts, The Types, Specification, advantages, disadvantages, and application of Lathe machine.

Let’s start by Introduction first,

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Lathe Machine Introduction:
Lathe machine is probably the oldest machine tool known to mankind. Its first use date back to 1300 BC in Egypt. The first lathe was a simple Lathe which is now called a two-person lathe. In this one person would turn the wood workpiece using rope and the other person would shape the workpiece using a sharp tool.

This design was further improved by the Ancient Romans who added the turning bow and lather the paddle (as there in the sewing machine) was added.

Further during the industrial revolution Steam Engines and water wheel were attached to the Lathe to turn the workpiece to a higher speed which made the work faster and easier.

Then, in 1950 servo mechanism was used to control the lathe machine.

From this crude begging and over a period of more than two centuries, the modern engine lathe has evolved.

Now we have the most advanced form of the Lathe which is the CNC Lathe.

HENRY MAUDSLAY, a British Engineer is considered as the inventor of a lathe.
Lathe Machine Definition:
A lathe machine is a machine tool which removes the undesired material from a rotating workpiece in the form of chips with the help of a tool which is traversed across the work and can be feed deep into the work.

It one of the most versatile and widely used machine tools all over the world.

This is also known as the ‘Mother of all Machines’.

Nowadays, Lathe Machine has become a general-purpose machine tool, employed in production and repair work, because it permits a large variety of operations to be performed on it.
Lathe Machine Parts:
Lathe Machine consists of following main parts:

- Bed
- Head stock
- Tail stock
- Carriage
- Saddle
- Cross Slide
- Compound rest
- Tool Post
- Apron
- Chuck
- Feed rod
- Lead Screw
- Spindle

I have also shown the different parts in the diagram.
let’s start from Bed first,
Bed:
The bed of the lathe machine is the base on which all the other parts of the lathe are mounted. The bed is made from Cast iron or nickel cast iron alloy and is supported on broad box-section columns.

Its upper surface is either scraped or grounded and the guiding and the sliding surfaces are provided.

The bed consists of heavy metal slides running lengthwise, with ways or v’s forced upon them. It is rigidly supported by cross griths.

The three major units mounted on a bed are:

1. Headstock.
2. Tailstock.
3. Carriage.

The scrapped or the ground guiding along with the sliding surfaces on the lathe bed ensure the accuracy of the alignment of these three units.
Headstock:
The headstock is present on the left end of the bed.

The main function of the headstock is to transmit power to the different parts of the lathe.

It supports the main spindle in the bearing and aligns it properly. It also houses a necessary transmission mechanism with speed changing levers to obtain different speeds.

Accessories mounted on the headstock spindle are:

1. Three jaw chuck.
2. Four jaw chuck.
3. Lathe center and lathe dog.
5. Face Plate.
Tailstock:
The tailstock is a movable casting located opposite to the headstock on the way of the bed.

The basic function of the tailstock is:

1. To support the other end of the work when being machined.
2. To hold a tool for performing operations like drilling, reaming, tapping, etc.

It consists of the dead centers, the adjusting screws and the handwheel.

The body of the tailstock is adjustable on the base which is mounted on the guideways of the bed and can be moved to and fro.
Carriage:
Carriage is located between headstock and tailstock.

The basic function of the carriage is to support, guide and feed the tool against the job during operation.

*It consists of 5 main parts:*

- Saddle
- Cross Slide
- Compound rest
- Tool Post
- Apron
Saddle:
It is an H-shaped casting mounted on the top of the lathe ways.

It provides support to cross-slide, compound rest and tool post.

Cross Slide:
Cross slide is provided with a female dovetail on one side and assembled on the top of the saddle with its male dovetail.

The top surface of the cross slide is provided with T slots to enable fixing of rear tool post or coolant attachment.

Carriage basically provides a mounted or automatic cross-movement for the cutting tool.
Compound Rest:

Compound rest is present on the top of the cross slide. It supports the tool post and cutting tool in its various positions.

Compound rest is necessary for turning angles and boring short tapers and forms on forming tools.

Tool Post:

The tool post is mounted on the compound rest.

It is used to hold various cutting tool holders.

The holders rest on a wedge which is shaped on the bottom to fit into a concave-shaped
ring (segmental type),

which permits the height of the cutting edge to be adjusted by tilting the tool.

It is fixed on the top slide.

It gets its movement by the movement of the saddle, cross slide, and top slide.

The three types of tool post which are commonly used are:

- Ring and rocker tool post: It consists of a circular tool post with a slot for accommodating the tool or tool holder.
- Quick change tool post
- Squarehead tool post.
Apron:
The Apron is fastened to the saddle and hangs over the front of the bed.

Apron consists of the gears and clutches for transmitting motion from the feed rod to the carriage, and the split nut which engages with the lead screw during cutting threads.

*Two types of Apron* are extensively used:

- Incorporating drop worm mechanism.
- Friction or dog clutches.

Chuck:
Chuck is basically used to hold the workpiece, particularly of short length and large diameter
or of irregular shape which can’t be conveniently mounted between centers.

It can be attached to the lathe by screwing on the spindle nose.

*Four different types of chucks* are most commonly used in Lathe:

- Independent or four-jaw chuck
- Three jaw or universal chuck
- Collect chuck and
- Magnetic Chuck
Independent or four-jaw chuck:
It is used for irregular shapes, rough castings of square or octagonal in such jobs, where a hole is to be positioned off the center.

It consists of four jaws and each jaw is independently actuated and adjusted by a key for holding the job.
Three jaw or universal chuck:
It consists of three jaws that move simultaneously by turning a key and the workpiece automatically remains in the center of the chuck opening.

It is used for holding a round, hexagonal bar or other symmetric work.
Collet chuck:
It is mostly used in the places where production work is required such as in Capstan Lathe or automats.

It is used for holding the bars of small sizes (below 63mm).
Magnetic chuck:
They are of permanent magnet type or electrically operated. In Lathe, it does not have widespread use.

Feed Rod:
Feed rod is a power transmission mechanism used for precise linear movement of the carriage along the longitudinal axis of the lathe.

In some lathe machines instead of feed rod lead screws are used.
Lead screw:
The lead screw is used mostly in the case when the threading operation is to be performed on a lathe.

As we know for threading operation requires rotational movement of the job (workpiece) and the linear movement of the tool (tool post).

So rotation of the job is obtained by the chuck and the desired linear motion of the tool-post (as the lead screw drives the saddle when it is engaged) is provided with the help of a lead screw.

Lathe Machine Working Principle:
A Lathe works on the principle of rotating the workpiece and a fixed cutting tool.

The workpiece is held between two rigid and strong supports called a center or in a chuck or
in faceplate which revolves.

Lathe removes the undesired material from a rotating workpiece in the form of chips with the help of a tool that is transverse across the work and can be fed deep in the work.

The main function of the lathe is to remove the metal from a job to give it the required shape and size.

The normal cutting operations are performed with the cutting tool fed either parallel or at right angles to the axis of the work.

The cutting tool can be fed at an angle relative to the axis of the work for machining tapers and angles.
Products made by Lathe machine:
A variety of products can be made from the lathe machine.

Nuts, bolts, piston, ram, pump part, electric motor parts, sleeves, Aircraft parts, gun barrels, candlesticks, train parts, cue sticks, wooden bowls, baseball bat, crankshaft and many more things.

Lathe Machine Types:
There are 10 different types of Lathe Machine:

- Engine Lathe or Center Lathe
- Speed Lathe
- Turret lathe
- Capstan Lathe
- Toolroom Lathe
- Bench Lathe
- Gap bed lathe
- Hollow spindle Lathe
- Vertical Turret Lathe and
- CNC Lathe Machine.

**Engine Lathe or Center Lathe Machine:**
The engine lathe is the most important tool in the Lathe family and by far the most widely used type of Lathe machine.
Its name is derived from the fact that early machine tools were driven by separate Engines or central engines with overhead belts and shafts.

The operations which can be performed by the Engine Lathe machine are Turning, facing, grooving, knurling, threading, and many more operations that can be performed by it.

Engine lathe consists of headstock, Tailstock, bed, saddle, carriage and other parts.

- The headstock encloses the spindle and motor. It also consists of the gear and pulleys, which are used to change the gear speed and the feed rate.
- The tailstock is provided to facilitate holding the work between centers and permit the use of tools like drills, taps, etc.
- The cutting tool can be fed both in the cross and longitudinal direction with reference to the lathe axis with the help of the feed rod and the lead screw.

The Engine Lathe is available in sizes to handle to 1m diameter jobs and 1 to 4m long.
Turret Lathe Machine:
It is a production machine that is used for the production of products on a large scale. It basically handles heavy-duty workpieces. The distinguishing feature of this type of lathe is that the Tailstock is replaced by hexagonal Turret.

In this, several tools are set up on a revolving turret to facilitate in performing a large number of operations on a job with minimum wastage of time.

The turret usually accommodates 6 tools for different operations like drilling, countersinking, reaming, tapping, etc, which can be brought into successively working positions by indexing the turret.

Turret lathe is basically used for repetitive batch production.
Capstan Lathe Machine:
It is similar to the Turret lathe. Used for the mass production of the light-duty workpiece. It incorporates a capstan slide which moves on the auxiliary slide and can be clamped in any position.

This is best suited for the production of the small parts because of its lightweight and short stroke of capstan slide.
Speed Lathe Machine:
This is the simplest form of the lathe and consists of a simple Headstock, tailstock, and a tool post. Having no gearbox, lead screw, and carriage. Very high speed of the headstock spindle. The speed of the spindle ranges from 1200 to 3600rpm.

Tools are hand-operated. Cone-pulley is the only source provided for speed variation of the spindle.

Speed Lathes are intensively used in woodturning, metal spinning, and polishing operation.
Tool Room lathe Machine:

Tool Room lathe is a modern engine lathe that is equipped with all the necessary accessories for the accurate tool room work. It is best suited for the production of small tools, dies, gauges, etc.

It is a geared head driven machine with considerable rage in spindle speed and feeds. Its speed can range from very low to a very high speed of up to 2500 rpm.
Bench Lathe Machine:
Bench Lathe machine is a type of small lathe machine which has all the parts of the engine Lathe and speed lathe.

It is mounted on a workbench and is used for doing small precision and light jobs.

Special purpose Lathe machine Machine:
Special purpose lathe machine is used for performing the specific special tasks which cannot be performed by an ordinary lathe. Some type of special-purpose Lathe are as follow:
Gap bed lathe Machine:
In gap bed lathe, a gap is provided over the bed near the headstock to handle the job having flanges or some other protruding parts.

Mostly a removable portion is provided in the bed so that when it is not required it can be inserted.

Wheel lathe Machine:
Wheel lathes are a special-purpose lathe machine that is used for finishing the journals and turning the tread on locomotive wheels.
T- Lathe machine Machine:
T- Lathe machine is a type of machine which has a T shaped bed and is used in the aerospace industry for the machining of the rotors of the jet engine.

Automatic Lathe Machine:
As the name suggests automatic Lathe machine is a machine in which the complete work and the job handling movements required for the completion of the job are done automatically.

They are heavy-duty, mass production, and a high-speed machine.
CNC Lathe Machine:
Computer Numeric Control (CNC) is the most advanced form of the lathe machine. CNC lathe machine produces the most accurate products as compared to the other type of lathe machine.

In this machine, programs are being fed to the computer system which controls the overall working of the lathe.

It is used for large scale production. Semi-skilled workers are required for the operation of this machine.
Lathe Machine Specification:
In order to specify the lathe Machine completely the following parameter should be included:

- The length between the two centers:
- Height of the center:
- Swing Diameter over the bed:
- Maximum bar diameter:
- Tailstock sleeve travel.
- Metric thread pitches.
- Leadscrew Pitch.
- Motor horsepower and RPM.
- Shipping dimension: (length x width x height x weight).
a) The length between the two centers:

It is the measure of the maximum length of the workpiece that can be fixed between the lathe center.

b) Height of the center:

The distance between the lathe axis and the lathe bed is called the height of the center.

c) Swing Diameter over the bed:

It is the maximum diameter of the workpiece that can we turned on a lathe without hitting the lathe bed.

D) Maximum bar diameter:

It is the maximum diameter of the workpiece that can be passed through the hole in the headstock.

Other factors for the lathe specification are:

- Tailstock sleeve travel.
- Metric thread pitches.
- Leadscrew Pitch.
- Motor horsepower and RPM.
- Shipping dimension: (length x width x height x weight).
Application of Lathe Machine:
The following application of Lathe Machine:

- Metalworking operations,
- Metal spinning,
- Thermal spraying,
- In the automobile industry mainly in the crankshaft, woodturning, Glass turning operation, for forming screw threads, also used for reclamation of the parts, and many more.

A CNC lathe finds extensive use in the several tasks being performed by it in various industries like:

- **Textile**
- **Power Generation**
- **Defense**
- **Medical**
- **Plastic**
- **Aerospace**
- **Automotive**
- **Automobile industries.**
Advantages of the Lathe machine:

*Lathe Machine has numerous advantages*, some of them are:

- High-quality products
- High speed
- Saves time
- Saves Money

1. High-Quality Products: Lathe machine, especially the CNC Lathe machine, produce final products with high quality.

2. High Speed: The machining in the lathe can be done at a very high speed especially in automatic and CNC lathe machines.

3. Saves time: Lathe machine because of its extensive high speed and high accuracy saves a lot of time, resulting in the increased production.

4. Saves Money: Lathe machine helps in reducing the cost of machining because fewer operators are required for machining.
Disadvantages of Lathe Machine:

*Lathe Machine has some disadvantages* too, some of them are:

- The Initial cost is very high.
- The high skilled worker required for the initial setup.
- CNC machines can not use for small production.

This is all about Definition, Introduction, Parts, Types, Application, Advantages, Disadvantages, and PDF of Lathe.
FAQ:

What is Lathe Machine?
A lathe machine is a machine tool which removes the undesired material from a rotating workpiece in the form of chips with the help of a tool which is traversed across the work and can be feed deep into the work.

What are parts of the Lathe Machine?
The parts of the Lathe Machine are:
- Bed
- Headstock
- Tailstock
- Carriage
- Saddle
- Cross Slide
- Compound rest
- Tool Post
- Apron
- Chuck
- Feed rod
- Lead Screw
- Spindle

What is operation perform on Lathe Machine?
The operation we perform on Lathe Machine:
- Turning
- Facing
- Taper turning
- Eccentric turning
- Boring
- Drilling
- Reaming
Threading
Knurling
Scroll cutting

What are the types of Lathe machines?
There are different types of Lathe Machine:
Engine Lathe or center Lathe
Speed Lathe
Turret lathe
Capstan Lathe
Toolroom Lathe
Bench Lathe
Gap bed lathe
Hollow spindle Lathe
Vertical Turret Lathe and
CNC Lathe Machine

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