Production Technology: Theory and Practice
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Lecture - 27
Lab – 04

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Hello and welcome to the first lab session of the course, we are in the technical art laboratory of the mechanical engineering department of IIT Kanpur. This is the lab where we impart the hands-on training to the second-year students irrespective of their disciplines and the departments. all the under graduate students of the Institute which is now about 1000 students, go through this lab every semester.

In this lab, we have a series of turning machines these are the conventional turning lathes, we have a series of milling machines, series of turning as I said then the drilling machines we have the tool grinder, apart from that we have a series of computer numerical controlled machines that we will go through and we will have a demonstration as well. the students algo through a project.

And in the project, they apply the experience that they go through, which they have been taught which they have been given as a hands-on experience by the very experienced technical personnel in the lab, we have about 18 technical personnel in the lab, they are highly qualified and they guide the students, help the students in their projects. we will as well share this experience with you; that is the intention of the lab session of this course.

Now, this lab session will be divided into 2 sections, 1 will be the for the conventional machines there, we will have exercises on turning, on drilling, on milling, on the tool grinder and the second part will be on the computer numerical control machines where you will be shown how to program the parts in the CNC turning and milling, and then how to implement them.

I mean how to execute those programs to make the parts in the turning CNC machine or in the milling CNC machine. Altogether we are planning for about 10 hours for this lab session and of course 10 hours for the lecture session. let us have an overall look of the lab and then we will come back to the turning machine we will start with the lathe and then we will go about serially as milling then after that we will go to the drilling machine and on.

This is the technical art lab. This is the tool store that you can see from where the tools are being issued to the students. Those who go through the laboratory exercises here you can see the devices, these are the drilling and fitting section. They learn how to drill manually, how to tap manually how to file, what are the different kinds of files and on; there you can see the cutting section there we have the blanks from where they cut into pieces for making the shafts or the gears etcetera.

And there in front of you, you can see the drilling machines, those are the vertical drilling machines, and at the far end you can see the shearing machine and over there, there are 2 shearing machines; there and you can see the vertical drilling machines all together there are about 6 to 7 vertical drilling machines and on each drilling machine, the students themselves use it and drill the holes for the parts that they are using for their projects.

as I was telling you that about 100 plus students of the second year of IIT Kanpur, irrespective of their disciplines, they go through the laboratory works in this laboratory every day and they are given hands-on training by our highly reputed about 18 technical personnel. Now, we also take the precaution. This is for the safety of the students, we give them apron, we give them the glasses, we give them the gloves.

And it is mandatory for the students to come to the lab and carry out the experiments using the shoes and the full sleeve shirts without any loose shirts. For the girls it is mandatory to have the hair tied up at the back and on. all those are the precautionary measures that we take. Now, the students also go through the projects, they do the projects and some of the projects I would like to demonstrate.

This is one project which is the grass cutter and the entire project is designed by the students and fabricated by the students with the help of the technical personnel. Now in here as you can see that the grass will be fed here these are the parts with which the students have made using the 3-D printer or which is the rapid prototyping which is called nowadays as 3-D printer, we have few 3-D printers here also and the students are given the knowledge of operating them and making the program and making these kinds of parts.

this is the plastic part which is a clamp that you can see which is the clamp for the motor and these are the supports for the grass, the grass will come here and it will be driven by the motor and the grass will be cut from here, this is the cutter. this is a small project here if you see this is a spiral graph and this is also designed and fabricated by the students.

And here if you put the power on then you can see that there will be relative movement between the pencil and the table and you can see that there are different kinds of patterns that can be drawn and depending on where you are putting the pencil that pattern can be changed. you can see the pattern that has been made here and as I said, I repeat once again that the entire design is made by the students and all the parts are fabricated by the students.

While fabricating, while designing the students also implement the design knowledge, the fabrication knowledge and on. you can see some more of the students' projects. This is the rope making machine and then we have the mechanical arm. these kinds of projects are made by the students in a group of about 6 to 7 students and they design the entire project, then they fabricate the spur gear, bevel gear and they also assemble the parts.

This is another project which is the mixer and you can change the velocity; as you can see that this is a simple mechanism which is designed by the students and fabricated by the students as well; here if you see that this is the peanut crusher, also a very simple design, here the peanuts, with the cover, it comes here and they are being crushed here and it is segregated, the outer shell will be segregated because they are blown by the fan because they are lighter and the peanuts will be collected.

Here also it is manually operated, it can be operated like that. As you can see that this is the design which will crush the peanut and segregate the seeds from the shells and then the shells will be segregated there and the pills the brown pills will be coming from here they will be segregated overall. So, everything will be separately collected and this works very effectively also designed by the students.

Well, this is the turning machine which is known as the lathe machine, here we can make the cylindrical jobs, we can make the taper surface, we can make the internal hole as well and then we can also make the flat surfaces. Here what you see is, this machine, we have the 3-jaw chuck and this is for clamping the workpiece. The 3-jaw chuck is used for clamping the cylindrical piece where you have the centre of the cylinder which will be coaxial with the centre of the 3-jaw chuck.

And apart from the 3-jaw chuck we also have the 4-jaw chuck that we will be showing you little later. Now this here is the spindle, the chuck is on the spindle of the machine, this spindle is held by the headstock and the spindle is given different RPM, revolutions per minute, or the speed or a rotational frequency with the help of the headstock. Now, here we have the tool post and for clamping the tool.

Now, this tool post can be given 2 feeds and that the feed is the revolution per minute that is in millimetre per minute, that means how much the tool will be moving along the axis in case of turning along the axis of the workpiece in millimetre per 1 revolution of the workpiece. Now, here the tool will be clamped, these are all the turning tools, single point cutting tools.

The rotation of the spindle, since the workpiece will be clamped here, this will be the cutting speed. Now, the rotational frequency is given to the spindle and depending on the diameter that will be fixed here diameter of the job πDN , N is the revolution per minute, rpm that will define the cutting speed. Now the feed motion is given to the tool which is clamped here in the tool post and as I said that the feed is given in millimetre per revolution.

That means the movement of the tool in millimetre per 1 revolution of the workpiece. Now depending on the rotation and the feed given to the tool, there will be different kind of surfaces that can be cylindrical surface, then it can be the taper surface or an internal cylinder, everything will depend on the relative movement between the tool and the workpiece.

For example, if the workpiece is rotating and the tool is given movement of the feed, which is parallel to the workpiece axis then we will be getting a cylindrical surface which will be external cylindrical surface and if the feed given to the tool is not parallel to the workpiece surface, it is inclined to the axis of the workpiece then we can get either an internal cylindrical surface or an external cylindrical surface.

Now, the difference is that while we are getting the external cylindrical surface with the help of the tool which is mounted on the tool post for the external cylindrical grinding, for internal cylindrical grinding, we have to have a boring tool the boring tool will be fixed at the tailstock. The tailstock is used to fit the boring tool or the drill. It is also used to support the very long workpieces which will be mounted on the spindle with the help of the 3-jaw chuck.

Moreover, very long pieces, like rods which need some additional support because they are flexible, they are not very rigid, in that case they will be supported by different kinds of mechanisms, we will be showing it to you, these are the rests that will be mounted in the tailstock. We have the headstock and the tailstock, tool post which is mounted on the lathe bed.

The lathe bed is here. As you can see that these are the dovetail and this is the flat. This is for the tool post moving to and fro when the feed is given to the tool. Now apart from the longitudinal feed which is the feed given to the tool along the axis of the workpiece we can also give the feed to the tool perpendicular to the axis that means in the cross-feed direction.

This is the feed that is given manually which is the longitudinal feed that is parallel to the workpiece surface and this is the feed which is the cross feed which is given to the to the feed direction; this will be the longitudinal feed and this will be the axial feed or transverse feed. This feed will make the facing or a flat surface.

When the parting off is done then this feed is given that is perpendicular to the workpiece axis and the longitudinal feed is given for making the external cylindrical surface. This is the lead screw and the pitch of the lead screw defines how much the tool will be moving, the tool post will be moving when you are rotating this wheel.
And this is the handle which will help to switch on and switch off the machine and below that there is an emergency brake which is used to stop the machine immediately because with this handle, the machine still will have some inertia and it will not be able to be stopped immediately; this shaft that you can see is used for feed, this is called the feed screw.

Here is the lathe bed, this is the dovetail cross section and here we have the flat cross section. with the help of the dovetail, the lathe bed will support the tool post as well as the tailstock and the tailstock will have the support for the long rods or the workpieces which are clamped between the centres. The dead centre and the live centres will be mounted in the tailstock that will be for supporting the workpieces.

This is the headstock and inside that we have the gear train, gear mechanism, and the gear train defines the rotational frequency of the spindle and the workpiece which is mounted on the spindle these are the handles which will define different kind of revolution per minute given to the spindle. In this case there are tables as you can see. For the spindle rpm, if it is this, the handle is in this position.

This is the 112 and it has to be then A, if it is given in the B, it means here it will be in this position, this will be 710, if you have to shift from 112 to 710 you have to simply shift from here to here. This will give you the second value and here this has to be in the A, it is in the M, M has 2 values of the spindle speed 112 and 710. Either it is 112 if it is in the A and the A and M position or B in the M position will give you 710.

Anyway, this is not so important because this is only pertaining to this particular machine, in another machine the arrangement can be different. Overall, what I am saying is that you can get different kind of spindle speeds, RPM with the help of this. There are 8 spindle speeds that you can get starting from the 71 up to 1800 because these are not the modern machines.

Therefore, here it is only up to 1800 RPM that you can get and therefore high speed machining cannot be performed in these machines because the RPM cannot be taken more than 1800 and similarly, we have another table which is used for the feed and you can also get the threaded surface in that using the turning.

So here there will be a thread cutting tool particularly in the tool post. We will show you how to cut the thread, and how to operate the machine, how to get the spindle speeds and so on. You can see the inside of the gearbox which is attached to the headstock of the machine, here is the main drive and the power of the main drive has to be little more than the power that is required for the cutting so that there is no slip.

Now from the main drive through the belt and pulley system that you can see here, this is the driver pulley and this is the driven pulley here we have the flat 3 belts here and this is transmitted to the pulley here and this pulley on the shaft the transmission is given from there through the gear drive to the driver gear here.

So, from the driver gear through the gear transmission, as you can see from here, it goes and it is attached to another gear here, from here because this gear is on the same shaft as the gear inside which is attached to this gear, this will be rotating and in its turn this rotation is imparted to this shaft through the gear here and that the gear is sitting on the shaft which is going inside the gearbox.

Now, in this display board you can see the tools. These are the turning tools, drilling tools and the measuring instruments that are used for measuring the diameters, lengths etcetera. We will discuss about the tools and the measuring instruments in details in the lecture hours. But here I would like to show you some of them this is digital micrometre using which you can find out the value that will be displayed here digitally.

Also you can measure the value from the scale this is the linear scale and this is the vernier scale, using that you can find out the diameter of this cylindrical surface. This can be placed here and the diameter of this cylindrical surface will be displayed here. Here, this is the outer scale and this is the vernier scale.
From here you can find out what is the diameter of this or you can find out the thickness let us say you want to find out the thickness of this scale. That can be found out. It has to be held in between the 2 jaws and the thickness of this will be displayed here; normally they are quite accurate, similarly, we have inside micrometre.

This is used if you have to find out the inside diameter of cylindrical hole. This will be put inside this hole then you can fit these 2 jaws inside the hole and you can measure the diameter from the scale, this is one scale and this is the vernier scale. The bigger scale will give you the value and the decimals will be found out from the vernier scale.

The details of the vernier scale and how to read the vernier scale we will be discussing in the lecture class when we will discuss the measurement. Let us say you have nut and you have to find out the internal diameter or the diameter of this nut. It can fit in these external jaws like this. Then you can find out the internal diameter of this nut from this scale which is here you can see that this is about 20.

It is almost let us say 20 something, that ‘something’ you can find out from the vernier scale that we will be discussing in details in the metrology course. Here you can see that this is the outside micrometre which is very similar to the one that we have shown here. This is the digital one where the reading will be displayed here and there is no digital display here.

Here you have to find out the measurement from the scale that is here that is the linear scale, outer scale, and the vernier scale. Now, here this is the bevel protractor, this is used for measuring the angles and here you can see that this is the lens through which you can find out the value, this is rotating and this is the vernier scale as you can see, through this lens you can see the vernier scale as well as the main scale.

From here you can find out what is the value of the angle that you are measuring. Here we have the digital Vernier calliper and the digital Vernier calliper with respect to any hole either it is an internal diameter if it is in diameter of a shaft or it is the internal diameter of a hole. That also can be found out from these jaws and from these jaws you can find out what is the external diameter of the shaft and this will be displayed in this.

This will be displayed digitally the value of this gap is displayed here as 238.44, it will be in some unit that unit can be fixed here and you have to set the 0 . So, if you set the 0 and then if you take it out, right now what it is showing is 17.85, this is the gap which is shown as the 17.85 it is given in millimeter.

It is useful and it is quite convenient because you do not have to read in that case the scale and the main scale in the vernier scale and you can find out what is the value. Here it is the Vernier with the dial indicator, instead of the display you can have the dial indicator where you can directly find out what is the value of the diameter.

This is for the diameter of shaft and this is for the internal hole that is diameter of the internal hole that means you are placing it inside the hole and you are finding out what is the value of this diameter from the dial indicator. is The principle is the same as in here only thing is that here it is displayed and here it has to be read through the dial indicator.

But the principle used is the same; this is a very popular manual Vernier calliper there is no difference between these 2, only thing is that this has a dial indicator and here you have to manually find out and read the value.

These 2 jaws can be used and again then you can find out the value by reading the main scale and the vernier scale as I said that this we will be discussing in the metrology class in details that how this can be read and you know that there is a least count concept in the Vernier, how to find out that and how to measure that we will be discussing in the metrology class.

Next that we have is a stainless steel scale that you know, then we have the thread gauge which is useful because in that case you have to just match one of them and you can find out each one has the value written on this and you can find out what is the value of the pitch here we just match and see which one is matching here; there are 2 sets of that and accordingly.

You can find out the value that will be written here on each of them. this is the fishtail gauge, here you can find out for the bigger threads, what will be the pitch or what will be the angle between the 2 sides of the thread, we will show it during the machining how this angles can be found out this one as you can see, this is called the knurling tools and there are different kinds of knurling that are there on the tool.

And we will have a turning operation where we will be using this knurling tool to show you how the knurling surfaces can be obtained. Let us see the use of the knurling surfaces. This is a knurled surface as you can see, this is for gripping and also very fine knurling is used in different objects to retain the lubrication when particularly the two objects are moving with respect to each other.

This is the process which is called the knurling and the tool is called the knurling tool; this is the tool which is called the carbide tip boring tool. Carbide tip is because, this tip only is made of the carbide, it can be tungsten carbide or silicon carbide.

When we will discuss the tool material in the lecture class, I will tell you what these carbides are for and why these carbide tips are used in the tool. Let me discuss a tool with you. This is a tool which is the single point turning tool and this is called the left-hand turning tool, we have the left hand turning tool as well as the right hand turning tool.

These are the turning tools which are used on the lathe to get the cylindrical surfaces on the lathe machine. Here we have the 6 angles and the 2 main surfaces, 1 surface is the rake surface and another surface is the flank face or flank surface. Now, the angles that the tool must have, these are the rake angles, the flank angles and the cutting-edge angles.

Those angles in details we will discuss in the theory class, but you can see here in this tool, there are different inclinations, one inclination you can get on the rake face, one inclination which is different from this will be on the flank face and another inclination which is different from the flank face as well as the rake face is the side. As you can see that there are 3 faces with 3 different inclinations.

Therefore, there will be 6 angles altogether, 3 sets of angles, 1 set of 2 rake angles, 1 set of 2 flank angles, and 1 set of 2 side cutting edge angles. Those 6 angles together will define the entire tool which is the single point cutting tool or sometimes it is called a turning tool or lathe tool. So, we have the left-hand tool or the right-hand tool; here is the right-hand tool, principle is the same.

But depending on how this is shaped, either in the left or in the right. This is called the right hand turning tool or the left hand turning tool. Here you can see that this tip is different from the one that I have shown you and that is called the radius profile tool. That means if you have to make a profile, the same way as the profile shown here, then this tool can be used with the cross feed.

The feed then can be given towards perpendicular to the axis. In that case what you will be getting is the groove which will have a radius of the same value which this tool is having, these kinds of tools are used for that purpose for the profile cutting. Now here you can see a tool which is used for making the internal threading. This is the threading tool which will be clamped on the tool post and this will go inside the workpiece in this way the workpiece will be rotating.

We will show you some thread cutting operations, but mind it that this is for the internal thread cutting and this is the tool for the external thread cutting. External thread will be held on the tool post and it will touch the external cylindrical surface and the feed will be given parallel to the workpiece in both cases either it is an internal thread making or it is an external thread making.

Now here also we have to maintain the angles which will be little different than the left hand not the right-hand tools; here the most important angle is the angle which is given by these 2 surfaces. This is the thread angle that is important, in this case this is the tool holder and in this we have a tip which is used for the cutting tool. The entire body of the tool is of a single material.

Either it is a high-speed steel or any other steel by which this tool is made, here not to waste much material because the tool material is costlier, only the tip is made of that tool material and that tip is attached to the tool as you can see that this can be loosen and this tip can be taken out and another tip can be inserted when this tip will be worn out. This is the tool holder that can be used multiple times even if the tool tip is broken, in that case another tip can be inserted here.

This is called the inserted tool tip, insert a tip tool here this is a drill which is used in the drilling machine to drill the hole or it can also
be used in the turning lathe for drilling an internal hole in a cylindrical surface. I was telling you there during the when we were describing the turning lathe In that case the drill has to be mounted in the tailstock, drill does not rotate in that case.

It will be fed towards the workpiece or parallel to the workpiece surface and the workpiece will be rotating, workpiece will be clamped in the 3-jaw chuck or in the spindle by the 3 jaw chuck mostly because it is a rotating workpiece and in that case the internal hole will be produced, internal hole will be fabricated This is the tool which is the in that case is a drill.

But the difference as you can see is the taper surface and these are the cylindrical surfaces, meaning that if the diameter of the drill is more than 10 to 15 millimeter in that case you have to use the drill with a taper shank, this is called the shank which will be fitted in the drill chuck, the drill chuck is here this is called the drill sleeve, it goes in here and it sits.

This will transmit through the tapered surface of this chuck or of the of the drill sleeve the torque given to the tool in this case this is the drill. So, there are 2 types of drills, one with the cylindrical shank and the other with the tapered shank. Cylindrical surface of the shank is used when the tool is of smaller diameter, let us say around 10, 15 millimetres.

For drills with the diameter more than that, it has to be a taper shank because the torque carrying capacity has to be more in this case. The drill will be fitted here and this is the taper which is called the Morse taper. Where it is fitting in the drill sleeve, the internal taper hole should also has to be the Morse taper.

Drill fits in the drill sleeve, and for removing the drill out of the drill sleeve, a large force is required. Now here what do you see is a window in the drill sleeve and the drill end which is called the drill tang.

This tang is given so that the drill can be taken out of the drill sleeve. As I was telling that if you put the drill here the Morse taper on the drill shank and inside the drill sleeve, will fit very tightly because as you can see that when this will be rotating, the torque will be transmitted to the drill through the friction only, therefore, there should not be any relative movement between the drill sleeve and the drill.

Otherwise, it will slip. So, there should not be any relative movement, they should move together. Therefore, it will sit very tightly and it is difficult to take out the drill. There is one wedge shaped tool that is called the drift which is driven here since it is the wedge. So, if you hammer it from here the drill will come out of the drill sleeve.

This is called the drift or the wedge and this is used for taking out the drill from the drill chuck, drill sleeve and this is the tang. This is not used for transmitting the torque, this is used to just remove the drill from the drill holder or the drill chuck here using the wedge shaped tool like that.

That problem will not come here because in this case we have a drill shank of cylindrical surface. Here the torque is transmitted with a different principle than the principle used here. Once again, I will repeat that the torque is transmitted through the spindle and the chuck with the help of the Morse taper only; among the other tools here you can see that this is an adjustable spanner. Adjustable because with the help of this screw, you can adjust the distance between the two jaws.

Different diameter of cylinders can be held between the two jaws and it has a very wide span. This is normal spanner everybody must have seen them and here you can hold the nut and tighten or loosen the nut of hexagonal or square head.

These are the 2 different ones and here the number will be given. According to that, you can select one of them either it is 7, this is called standard and this is a 5. These are the standard sizes and there are different spanners in a set of spanners, starting from 5, 6, 7 and all numbers. This I have shown that this is a drift and it is a wedge-shaped part.

This normally used for taking the drill out from the drill chuck. These are the keys which are called the Allen keys and the Allen keys are used for tightening such kind of screws, here if you see the head, in this head, these Allen screws will be fitting well and then you can rotate that, the screw can be put inside the threaded hole. These are the Allen keys. They are of different sizes, this is bigger; this is smaller and this is the standard dial gauge.

And this dial gauge is used for measuring the height the out of roundness, out of cylindricity, and many other purposes for many other purposes, this kind of dial gauges are used. For that, you put it on a metallic surface then if you rotate this there is an electromagnet whichwill put the base firmly on the metallic surface and then you can use the dial indicator for measuring with the help of this.

You can load that or you can change the angle and on. As I said that for different purposes such kind of dial gauges are used and those dial gauges are of different least counts meaning that what is the minimum size that you can measure using such kind of dial gauges, there are fine dial gauges, rough dial gauges; For fine dial gauges, least count will be very less, let us say 0.01or 0.002.

And for the rough dial gauges you will have the higher least counts, these are the two parts which are called the centres. This is the revolving centre which revolves along with the spindle or the tailstock and this is a dead centre which does not rotate which is fixed. These are the centres which are used for supporting the long shafts that I was telling you when describing the lathe functions.

That between these two centres the long rods can be supported so that the entire length of the rod can be turned and here normally the dead centre is placed in the tailstock and the live centre or the revolving centre in the headstock. between these two centres the cylindrical jaw can be held and while giving the motion or the movement to the shaft, the device which is used is the dog carrier that I will show you a little later.

So, once again this is the revolving centre and this is the dead centre, between these two centres the long cylindrical jobs can be held for that in the long cylindrical job the centre hole has to be made within those centre holes the centres are inserted and this shaft will be rotated between these two with the help of lathe dog or lathe carrier.

This is the device where the shaft goes in it and the rotation is imparted with the help of that which is attached to the spindle; we will show it to you how from the chuck the rotation can be imparted to the cylindrical shaft with the help of this dog carrier. This is a marking block; this marking block is very simple this is used for marking the plates where you have the centre or you have the centre hole or you have the other margins.

These are the pins and these are used for marking the block. The material of this pin has to be hard that it can scratch the other material and should not wear out because these are very sharp pins. This is a drill chuck and this drill chuck I have already told you that as you can see that there is a Morse taper similar to the one that is there on the drill shank.
In this drill, the diameter of the drill is higher, and hence you have Morse taper shank. Similarly, here also you will have a Morse taper shank along with the tang here. This tang is to take out the drill from the drill holder. Here if you see the drills that are having the cylindrical shank those can be fixed here and these are the as you can see that this is a straight shank drill.

This can be placed here and then again tighten so that it stays here. As you can see that this is a cylindrical shank, it is not the taper shank. Therefore, it will be just placed like that and tightened.

If you remember your mechanical pencils, mechanical pencils have the same mechanism here. Very often these are called the collet chucks as well. These chucks are very popularly used when particularly the diameter of the tool or the diameter of the shank and the tool is less, for small diameter of the drills normally such kind of drill chucks are used.

These are keyless, you do not need a key and they have the collet like in a mechanical pencil. Here we have a vernier height gauge and the name itself says that it can measure the height from a particular surface up to a certain level, this is movable, this jaw is movable.

Here also like a vernier scale, you have a main scale and the vernier scale and depending on the distance that you are measuring, you can find out the reading in the main scale and the decimals can be found out from the vernier scale according to the principles that we will be discussing in the metrology course lectures. So, this way you can find out different heights with the help of the vernier height gauge.

This is the lathe dog or the lathe carrier. This is used to impart the rotation when the shaft is located between the centres. Shaft is located between the centres, this is fitted in this in the 3-jaw chuck and then it will impart the rotation by clamping the shaft with the help of this nut here we have the 3-jaw chuck and these chucks are normally self-centring.

There is only one square hole in this 3-jaw chuck, you can see that that this can be rotated and once this is rotated all of them all these jaws will be together coming towards the centre in the sense that this can be tightened. If you put any cylindrical shaft here and rotate only this then all these jaws will be moving.

Either you can tighten a smaller diameter shaft or you can tighten a bigger diameter shaft depending on the range given here. Different machines will have different ranges from the smaller diameter to the diameter range between the smaller and bigger; there is a maximum and the minimum diameter.

This is therefore called the self-centering, meaning that always you can ensure that the shaft that you are mounting the axis of that shaft will be coaxial with the axis of the spindle or axis of the 3-jaw chuck. So, this is the self-centering chuck, and these are the jaws, each of these jaws look like this and on the other side you can see that this is a rack and here we have the grooves.

With the help of the jaws these teeth in the rack and with the help of these grooves it moves to and fro along these grooves to hold the bigger diameter or the lesser diameter of the cylinders. This chuck is a 4-jaw chuck and the 4-jaw chuck is used when the objective is not rotational not like a shaft, or a cylindrical.

Here the jaw is as you can see a square type. If you have to clamp the square type or non-rotational part then the 3-jaw chuck is not convenient because it will not not be self-centering here each of these jaws can be individually moved. For each of the jaws as you can see, there is a screw here. Take the Allen key put it in this screw hole and if you rotate then it will be either moving towards the centre one of them or moving away from the centre.

Similarly, you can see that there is another one which is for this jaw and there is another one for this jaw and so on. For 4 of these Jaws, we have individual screws for moving the jaws independently for clamping the non-rotational jobs like square or prismatic. Here there is another example you can see that this is also a 4-jaw chuck.

So, we have seen here a lathe dog and here if you see that is the serving almost the same purpose. This is called the dog plate with the dead centre. Here we have the dead centre and this is the dog plate which is similar to the one that we have seen.

I have shown it to you earlier with some of the tool holders we are having here. This is the tool holder, one tool holder is used in the turning lathe that you have seen and this is an adjustable one and you can clamp the tool with this square thread. While clamping the tool, to maintain the height you have different kinds of shims.

By changing them you can have different height, this height from the centre, from the bed surface. These are also the tool holders for small tools, tool can be hold here and this is another one where the tool can be held and for tightening this is the way that you are tightening the tool. There are different kinds of tool holders as you can see, depending on the tool size, depending on the tool type, you can have different kinds of tool holders.

Now, here is the follower rest and the steady rest, this is a steady rest this is a follower rest. These are used when the cylindrical workpiece length is very big. If they are held between the centres, it is so lengthy that their stiffness cannot be maintained. To maintain that, in

between the centres there are such kind of rests which are used that we will show in the machine.
Now there are certain examples where the job may not be between the centres, but from one centre and then on the other side one of these rests can be used that will show you in the machine itself. I told you about the rest, that is follower rest and the steady rest here are the examples. This is also a lathe machine and here you can see that a solid cylindrical job is mounted which is very lengthy and this is not connected to the dead centre.

Here this jaw is only mounted on the 3-jaw chuck. Therefore, if suppose you turn from this side, there will be a lot of bending because the bending moment will be very high since this length is very big. Therefore, there is a steady rest which is required to hold it here. So that the rigidity of this shaft can be maintained and whenever the machining takes place, the rigidity of the part or the cylindrical job is enough to withstand the force and not getting bended.

We have just shown a steady rest to you where the rest is not moving, it is supporting the shaft but it is not moving along with the tool. Such kind of follower may create some disturbance in the tool movement. This does not happen in the case of the follower rest. This is also a turning machine where you have a very lengthy job mounted between the centres that is between the 3-jaw chuck and the centre, this is the revolving centre and since it is very lengthy, therefore, there is a rest.

Now if you put a steady rest here in that case the passage will be restricted and the job cannot be turned along the full length of this shaft. Therefore, this kind of follower rest is used which will move along with the tool as you can see that as the feed is given to the tool the follower rest is moving along with the tool. Therefore, there is no restriction of the tool turning the shaft along the full length of the workpiece which is not there in case of the steady rest.

That is the difference between the steady rest and the follower rest, steady rest does not move along with the tool post, along with the tool but the follower rest moves along with the tool so that there is no disturbance in the process in the turning. Thank you for your attention.
(Video Ends: 01:03:14)