Manufacturing Processes II
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Lecture No.23A
Construction, Operation and Tool Layout of Semiautomatic and Automatic Lathes

Good morning young friends! Now let us come to our subject Manufacturing Processes - II

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and the module that is ongoing General Purpose Machine Tools and topic today is Construction, Operation and tool layout of Semiautomatic and Automatic machine tools like lathes.

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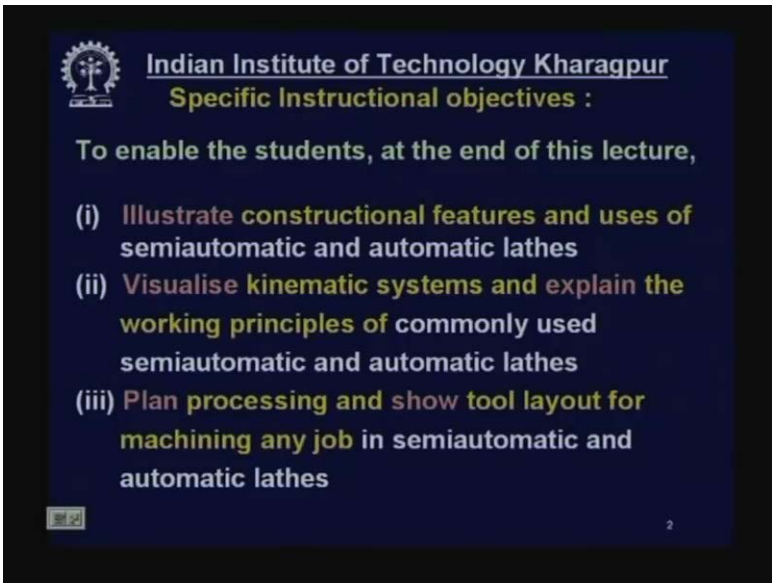

Now the specific instructional objectives of this lesson will be the constructional features and uses of semiautomatic and automatic lathes. Kinematic systems and the working principles of commonly used semiautomatic and automatic lathes, processing and tool layout for machining any job in semiautomatic and automatic lathes. Now why lathes only? Our topic should be you know automatic and semiautomatic machine tools but within this limited scope, it is really very difficult to cover all these machine tools automatic and semiautomatic particularly after such an advancement and since lathes are most important and most widely used amongst the machine tools so we shall cover only the semiautomatic and automatic lathes. The knowledge of which can be stipulated to other machine tools and you can read also onward from other books.

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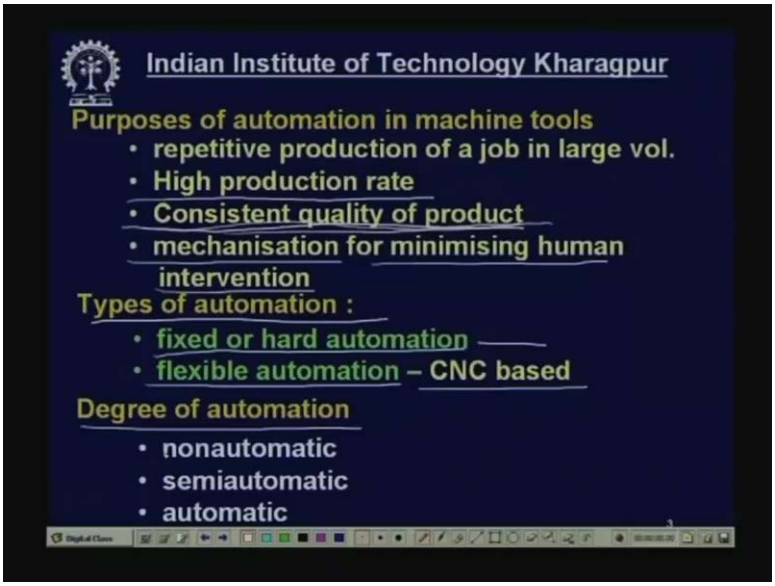

Now the purposes of automation: First which is applicable to any machine tool irrespective of lathe; Purposes of automation in machine tools. These are repetitive production of a job in large volume that is batch production, lot production, quantitative production, mass production like this then high production, high production rate that is this huge amount or volume of production has to be produced not in only large volume but also very rapidly. But it is a consistent quality of the product and while manufacturing the quality of the product has to be maintained and that has to be maintained through out the volume of production consistently not this will fluctuate, then mechanisation for minimising human intervention for human involvement has to be minimised and while minimizing human intervention, we can also reduce the consequences of human intervention that is the mistakes, faults, emotions and exaggerations all these things.

Now types of automation. There are two types of automation. One is called fixed or hard automation which is conventional and most widely ongoing where change of the product cannot be accumulated that easily. Whenever the job changes, lot of change has to be incorporated. Now the modern system is flexible automation is very modern since 1970 it has been introduced in manufacturing by machine tools and these are basically CNC based Computer Numerical Control based like CNC milling machine, CNC drilling machine, CNC electronic machine, machining centre and so on. Now the degree of automation; There are different degrees of automation, non-automatic, semi-automatic and automatic. Now what is mean by this? You know when you machine a job in a machine tool say lathe, so first of all you have to mount the job, mount the cutting tool adjust the speed for depth of cut.

These are all handling operations or auxiliary operations which are not directly connected with the chip formation. There is another set of operations which are directly connected with chip formation machining operations like turning, drilling, boring, facing, centering and so on. The processing operations or machining operations will be obviously automatic but whether a machine tool be called automatic or non-automatic or the degree of automation we have decided to what extent the handling operations or what is called the auxiliary operations like tool mount job mount etcetera are done automatically and non-automatically. Non-automatic machine tools mean where what irrespective of the processing operations, the auxiliary operations are done manually. In automatic machine tools when not only the processing operations but almost all the handling operations or auxiliary operations will also to be done automatically. Then it will be called automatic machine tool in between where see around 50 percent of the handling operations will be done automatically and 50 percent say manually irrespective of processing operations then it will be called semi-automatic.

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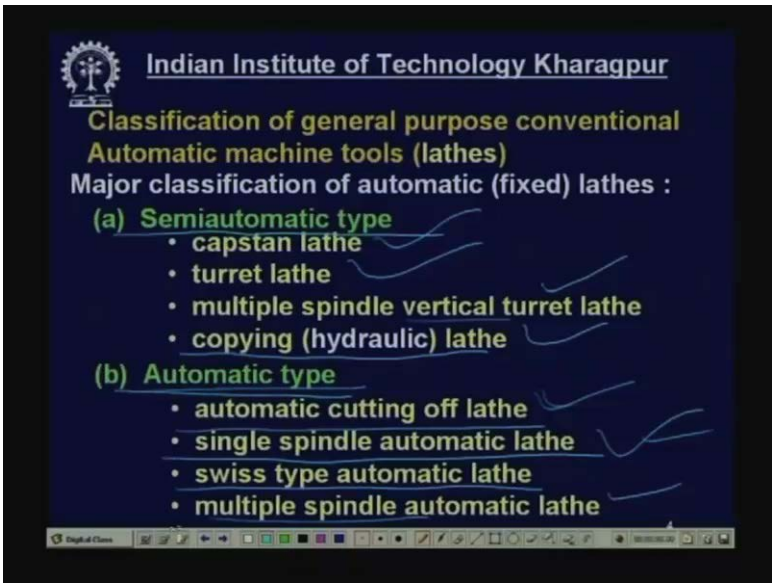

Now the classification of general purpose conventional automatic machine tools: As I told you that our discussion will be confined to lathes only because the scope is very limited. Major classification of automatic that is fixed automatic, fixed automation which is very conventional type lathes. We are not going to cover to that extent that is flexible automation that be done in some other subjects or if in any news scope comes. Now the classification of automatic lathes; One group is called semiautomatic one group is called semiautomatic under them capstan lathe turret lathe multi spindle vertical turret lathe, copying that is hydraulic copying lathe. There can be few more say relieving lathe or say multiple tooling lathe facing lathe. These are also to some extent semiautomatic if not semi at least quasi-automatic. Now automatic-type; In automatic lathe group automatic cutting off lathe length which is not that frequently used or widely used but single spindle automatic lathe are the most common automatic lathe, swiss-type automatic lathe. This will be discussed in detail. Multiple spindle automatic lathe for further increasing productivity.

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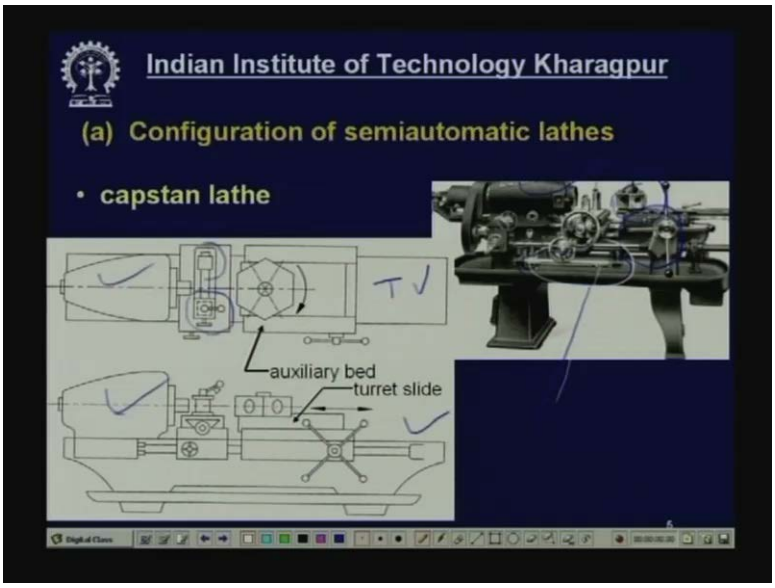

Now the configuration of semiautomatic lathes: Now within semiautomatic lathes, the capstan lathe, turret lathe, hydraulic lathe and multi spindle turret lathe. Now let us start with the capstan lathe. Here you see the capstan lathe configuration is shown over here. This is front view and this is top view. This is plan and this is elevation and this is the real photographic view of any capstan lathe. Now this is semiautomatic. Now very quickly look at it what is the basic difference or characteristic features of this semiautomatic lathe like capstan turret from say central lathe not automatic. This capstan is turreted do not have any tailstock number one. Instead there is a turret hexagonal turret in this machine the spindle rotates at high speed for high production and smaller job size.

There is a turret which holds number of cutting tools six cutting tools can be held in 6 faces of the turret which will come forward time to time. The front slide will have 4 tools and the real side one. So many cutting tools can be placed in advance so that the tools can be selected and put into action very quickly that will save time the speed changes will be also done very quickly in this semiautomatic lathes. These are semiautomatic and used for suitably economically viable for batch production or say small lot production. Now here you can see, this is the turret which holds the tool this is the headstock and this is the saddle or auxiliary blade and this is a rod or shaft which is used for you know stopping, controlling the length of travel of the cutting tools.

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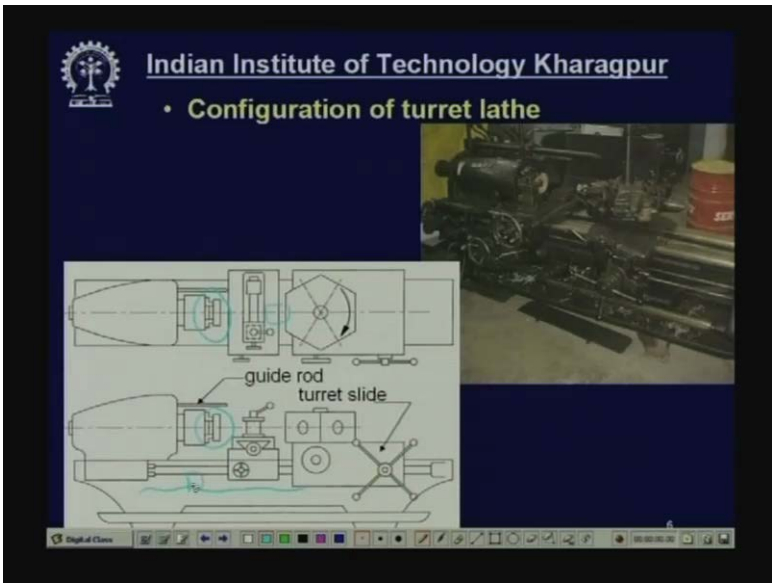

Now see the configuration of turret lathe. Now capstan lathe and turret lathe are slightly different. You see this is capstan lathe okay the configuration top view and front view and this is the true pictorial view whereas turret lathe. This is the turret lathe pictorial view and these are the front views. So the schematically they look alike but practically they are quite different. Now identify what are the differences? First of all from this picture you understand that turret lathes are heavy duty, large volume and heavy duty robust lathes that is number one. Second capstan lathe you noted that turret slides the turret is mounted on a slide mounted on a slide and the slide moves on an auxiliary bed which is fixed on the bed and appropriate place and the length of stroke is small because it is low duty work whereas in turret lathe, the turret is mounted on the saddle which directly travels over the bed with a large stroke length. So it is a heavy duty lathe. Another difference is that in capstan lathe, the job the blank is always bar type rod like but in turret lathe it can be rod like as well as chucking type.

Here you see that chucking type. The jobs are held in the chuck unlike capstan lathe. These are heavy duty but both of capstan and the turret lathe are semiautomatic and used for batch production. There is another difference. If you want to cut thread say external screw thread in capstan lathe then one die has to be fixed on the one of the faces. One die called self-opening die, but in case of turret lathe. There will be a lead screw and a half nut engaging which the thread will be cut. So these are the basic differences between capstan lathe and turret lathe. Here you can see the differences. This is the turret, this is a headstock and this is the shaft or rod to control the length of the tool travel and so on. What happens not moving something wrong.

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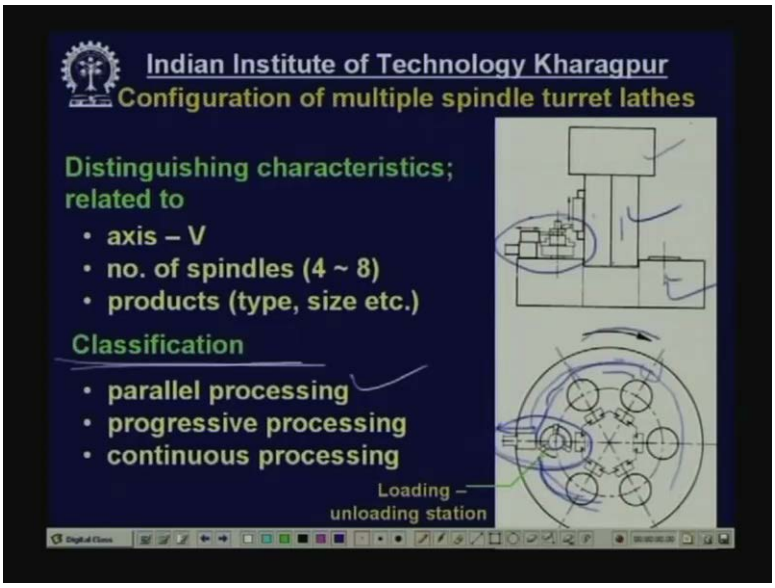

Now next this is multi spindle lathe, configuration of multiple spindle turret lathe. Actually why it is multi spindle? The main purpose is to produce in large quantity and faster rate. So instead of having only one spindle in lathe, now you will be having 6 spindles and all the 6 spindles will be engaged for manufacturing say so many pieces at a time. So this is much more productive. Now configuration of multi spindle turret lathes. Distinguishing characteristics of such lathes related to axis. Now axis of such lathe will be always vertical. Why vertical? If it is vertical, it occupies less floor space. Secondly, it takes the advantage of gravity and third loading and unloading of the job is more convenient. If the axis of such a large machine tool is vertical number of spindles will vary from 4 to 8 with increase in number of spindle productivity will increase but not exactly proportionally. If the number of spindle is 8 productivity may be 6 times.

Now the products type: The type which is the chucking type. Mostly you will see the chucking type job. So there were six chucks mounted on the six spindles and size usually the job size is little bigger larger size and other thing is here the products which require lesser amount of its a few machining operations only say turning, drilling and facing. So when these numbers of operations and kind operations are very simple only then, this multi spindle lathes are more feasible. But if the job is complex and relating requiring lot of machining work, then single spindle is better.

Now the classification: Multi spindle turret lathes are again may be 3 types the same the configuration looks alike. But the principle of working will be slightly different depending upon the parallel processing. Parallel processing means here this unit say this unit or say this unit they looks like one machine tools so on spindle one tool and one tool will be mounted on the ram. So this is the ram along which on the surfaces of the ram the cutting tools are mounted on the slides which move up and down and there are certain tools which are fitted on this carrier table. This is called carrier table which who can move radially for some work like say grooving, facing etcetera or short tapering. Now in parallel processing all the 6 pin the carrier this they do not move. As well as the ram also do not move but only the tools move. So here all the 6 spindles

will be loaded simultaneously by 6 jobs identical and then it will be started machining so in each station you will get only one job and so point of time you will get 6 jobs ready completed and you unload and load fresh.

So neither this do not rotate. Now the progressive processing which is really employed where number of machining operations required is relatively large say 6 or 8 operations in that case. Suppose this is the loading station. In this loading station the operator will load a job in this chuck on the spindle and then this will rotate. So this job will be carried to the next station where another set of tools are ready to do some machining work. So the ram will remain fixed where the tools will move, then this will go to the next station for few more operations and this way all the operations will be completed and the job will come back to this station and job will be unloaded. In this way all the spindles will be kept engaged and you get 6 times productivity. Continuous processing where both the ram and this carrier rotate simultaneously and each unit functions as a separate machine tool.

Suppose here just two machining work has to be done. One say turning and one say grooving. Job is mounted here, after that this job will move along this path along this carrier and while coming to this position. These two operations will be complete. Now when this will be moving like this, the other stations will be also a coming slowly and one by one will be loaded. So all these things will be continuously done that is one job will be done in one chuck on one station only but the station will move like that. So, all of them will give huge production.

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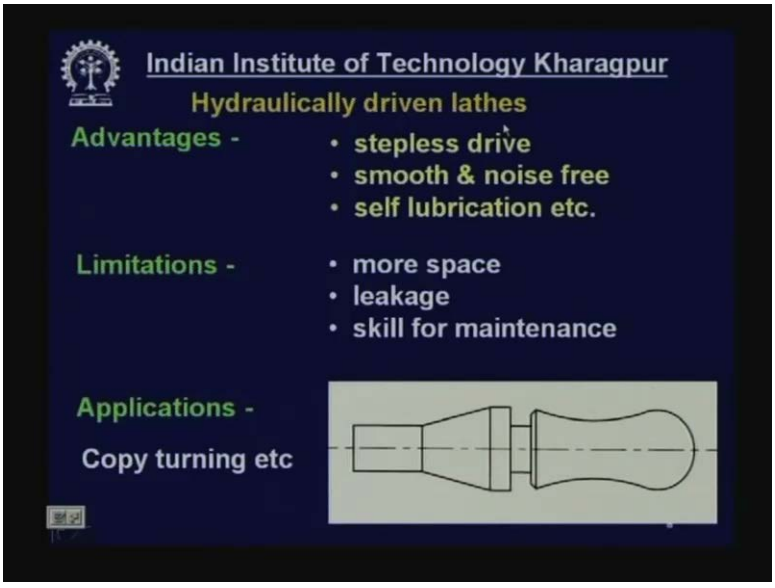

Hydraulically driven lathes: now in many machine tools they are hydraulically driven. There are certain advantages or conveniences of hydraulic drive like this give a stepless drive for the speed and feed can be steplessly varied operations are smooth and noise free and self lubricating because of the continuous flow of the lubricant or this hydraulic fluid. But there are certain limitations also for which they are not that popular and not always preferred for specially small

machine tools. What are limitations? It occupies more space and space is very expensive, leakage problem and a lot of skill is required for maintenance and repair because the kind of defect and repair are very complex. Applications: This hydraulic machine tools especially lathes they are used for copying type of work or contouring for producing contoured surface. Suppose this kind of job which has got a straight surface, taper surface a group and then aim smooth curved surface. So this kind of work are done normally in copy turning hydraulic copying machines or copying lathes.

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Now the configuration and use of automatic lathes: So far we discussed semiautomatic. Now come to automatic where all the processing operations and the handling operations will be done automatically. Only time to time a long bar or a blank will be fitted from magazine. Now the distinguished features of these automatic lathes shown over here the photographic view are automation. Yes, it is a fully automatic and this is the fixed automation type or hard automation type. There is no computer, no numerical control, production it is for use and first production that is for mass production or larger production job. Job will be rod like is a bar like and of small size say diameter within say 15 millimeter and length of the job will be around say 10 to 30 millimeter. Speed, see the diameter of the job is small so the speed will be high but only few speeds will be available may be 4 or 6 speeds will be available because it is a mass production large number of speeds speeds are not required as is required in central lathes tools. Now how many tools can be mounted? This is the hexagonal turret were you can mount 6 cutting tools and there are 5 radially moving or sliding tools. One is the front slide, real slide, vertical slide and then 2 inclined. So 5 cutting tools 5 plus 6 cutting tools can be mounted of different type. The cost yes cost will be obviously high.

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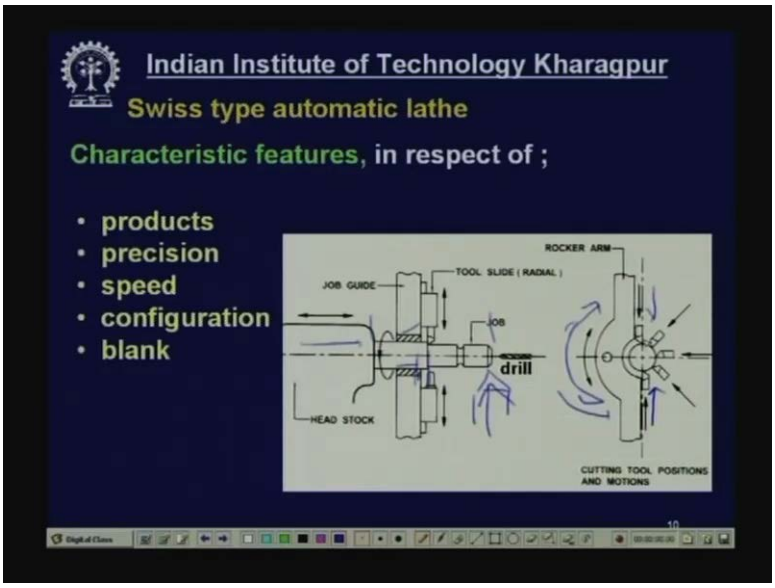

Now the Swiss type automatic lathe. Now the characteristic features. These machine tools are used the kinematic diagram will be discussed in more detail later on. But now we discuss the configuration and characteristics and application. These lathes are very small, very tiny may be say about say only 6 inch may be 2 feet but they are fully automatic and highly precision and quite expensive. Now the characteristics are now the products products are really very small. It is a mass production machine, but the product side is very small, very slender rod like product as you see here are manufactured the diameter may vary from 2 millimeter to say 10 millimeter maximum. Length may vary from 3 millimeter to say 15 millimeter or 20 millimeter. Precision, yes is a highly precision the dimensional accuracy and finish will be in the order of microns, speed see the diameter is very small. The speed should very high configuration which has got very peculiar configuration.

1. You can see that the headstock travels. Now if you want to machine turn a rod like this a long rod, we normally start turning from this side. Now if we take a long rod, thin long rod projected so much, then there will be lot of bending force. To avoid that, there is a tool guide job guide through which the job is passed. This is called job guide, the bush and the cutting tools are mounted along the guide and the job is gradually projected. So the projection length or the bending moment will be always small. So the headstock will gradually move which will be equivalent to the feed motion. So this is the unique characteristics of this.

So tool will be almost stationary moving radially just after this tool job guide and the job will moving through that so whatever be the length of the job the over or the bending movement will be very small and there will be 5 radial cutting tools shown over here. One say front slide front slide real slide vertical slide and two inclined and these two slides will be mount tool slide will be mount on a rocker arm and this rocker arm will be oscillating when this will move in this direction this cutting tool will be engaged, when this will rotate in this direction this tool will be engaged into work. So this is the basic configuration of Swiss type automatic. These are

basically used for very small tiny components, mechanical components say this small pins used in say wrist watch or similar things.

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The configuration and use of automatic cutting of lathe; yes automatic cutting of lathe are much less used in common compared to single spindle automatic lathe. These are fully automatic but very few operations mainly cutting off or parting the rod in to say rods of similar size. In addition to that little turning, tapering, facing, centering may be done. This is automatic. Cutting of lathe these lathes are very simple and low cost multiple spindle automatic lathe yes these are again for mass production and a faster production so if the number of spindles are large the productivity will be improved. Now the major characteristics of this multi spindle automatic lathe compared to multi spindle turret lathe or here in automatic multi spindles spindles will be again 4 to 8 axis. Yes, the axis will be horizontal, not vertical like turret lathe machining requirements. Yes machining requirements should not be much say 2 or 3 machine requirements machining will be required per piece of job, blank will be bar type. Cost will be very high definitely and application application for small ring like or say rod like jobs. For example, say the inner races and outer races of bearings in case of mass production. These are manufactured in multi spindle lathes remember.

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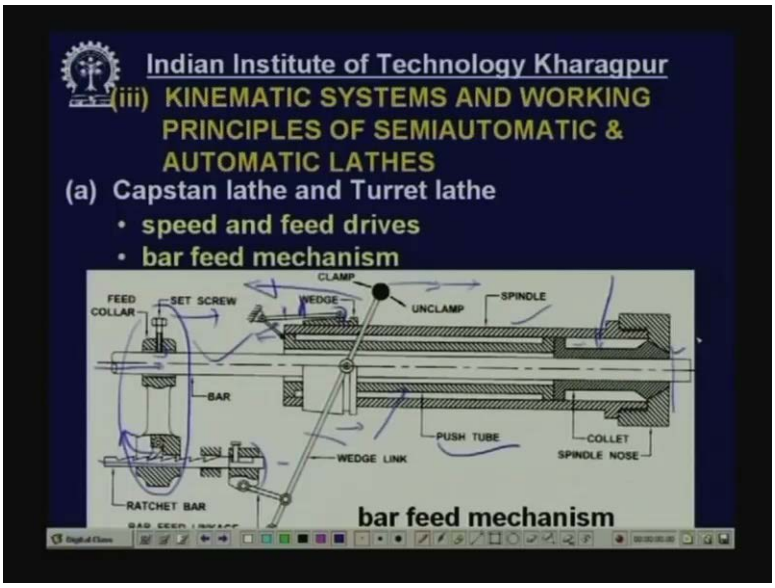

Now the next is the kinematic systems and working principles of semiautomatic and automatic lathes. Again we shall remain on lathes. Here, this is kinematic system which is very important for all machine tools for design purpose and manufacturing and working principle will depend upon what kind of kinematic system you have adopted. Now let us start with capstan lathe and turret lathe. As we have already seen that the configuration of capstan lathe and turret lathe. Both are semiautomatic lathes are very similar speed and feed drives are very similar. Unlike central lathes, this capstan lathe or turret lathe they have got very few speeds and feeds but those have to be operated manually but fast with the help of certain mechanisms. So speed and feed drive are simple but operated very quickly, manually bar feed mechanism. Yes because capstan lathe specially and turret lathe also are used with used for bar type of works, bar stock rod like job and this rod can be circular section tubular section or it can be hexagonal section hexagonal square or may be octagonal but regular polygon. So that this kind of rod can be held in collets, this is a collet okay.

Now the bar feed mechanism you see this is the bar which is held in this spindle. This is the spindle held, within the spindle there is a collet. So this collet holds the job tightly. How the collet has got a tip of end. Against the taper end of the spindle, this collet is pushed by a push tube. This is the push tube this is the push tube this push tube is pushed by this taper ring. Now after working here, say machining is over. Now the bar has done the job after completion has to be dropped. Now for the next job this bar has to be pushed forward projected from the spindle nose or to the bar feed bar feed for elementary operations are involved. Opening of the collet or loosening of the collet, then push the bar through the collet to appropriate distance or projection then climb the collet and return this pushing mechanism.

Now see how it is accomplished. Very simple first of all this lever which has manually moved in this direction. As a result, this ring will move in this direction. So this lever will fall in this direction. This will go back, so the push force is withdrawn. The collet will be will spring back and open. Now if you move it further, this is rotated further then this end will pull this ratchet in

this direction along with the ratchet and paul, the whole system will be moved forward along with that the job will be also moved because it is held by a screw. So this will be moving and after it moves to sufficient distance, then this clamp is this tube. Sorry this bar is moved in the opposite direction. First this ratchet goes back freely because this paul can move freely in this direction. But it cannot move in this direction. So this will go back and at the end this ring taper ring will go under this roller. As a result, this lever will go up, this labor will go in and push this push tube and tighten the collet. So this is how the bar feed is accomplished and this is true for both capstan and turret lathe for bar feeding type.

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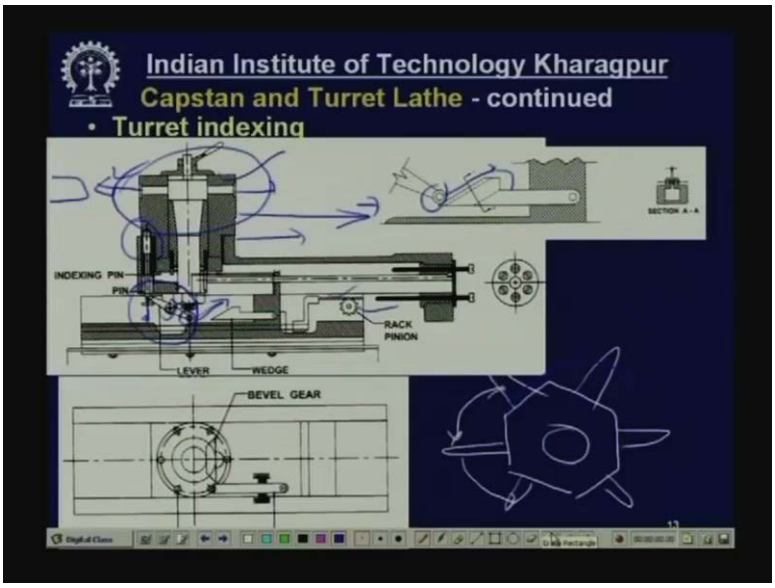

Now come to the turret indexing. Both capstan and turret lathe are provided with a turret. This is the turret which may be a mostly hexagonal. This is hexagonal, it can be it can look like a circle, but it can be basically hexagonal the hexagonal turret and the tools are mounted on the faces, so 6 cutting tools all right. Now this is turret were the tools are fitted here. Say one cutting tool is fitted here a tool another tool here side axis tools and after the tool this is the work piece. So after completion of the work, this turret this entire turret slide has to be pulled back and this will be done manually by rotating this pinion against this rack. So the rack along with this thing will move backward.

After coming to the fullest distance, then this has to rotate. This turret this tool has to this has to go back and another cutting tool has to come in position for the next job to be done. So this turret has to be rotated by one sixth of a revolution if it is a hexagonal turret it is hexagonal turret. How this is done? Again this pinion will be rotated further in this direction. As a result this lever here you can see here is a lever hinged at the center. At one end, it is mounted on the pin and the other end there is a lever. Now before this hexagonal turret, this turret is indexed. It has to be loosened. How this will be loosen? It has to be held tight by a locking pin. This locking pin has to be withdrawn. How this is withdrawn? Now when it is moved in this direction at the extreme end this roller will ride on this wedge. This see here this roller will ride along this wedge all right and

then fall here. When this will ride, this end will come down along with that the pin will be withdrawn. Now when the pin is withdrawn, the turret is ready to rotate free to rotate.

Now when you move it then there are 6 pins. Now there are pins let me clean it. Now you can see there are 6 pins mounted here, these are the pins. Now when it is moved back, one of the pin say this pin will be arrested by this lever this lever can little bit oscillate like this okay so when this pin will be arrested but you move it in this direction. So this turret will be rotated. This pin will go in this position and by that time, this lever has gone into this position here. So this end will go up and the pin will fit into the next slot or next hole. So in this turret in the surface there are six pin holes like this so this turret is indexed and the one sixth revolution is complete. After that when you move forward then this will again rotate this pinion by a lever and then this will go forward and this roller will come through this big hole just like a T slot. So the roller will ride on the surface and come through this larger gap provided here are shown here. But how far it will go?

Now when it goes forward, this forward movement can be accomplished either manually or automatically by engaging a clutch. Whatever you do, what will be the length of travel or end of travel? That will be decided by when this screw end will strike here the stop, this cannot be moved further either manually or automatically the clutch will open or the person will fill. So this screw decides the end of travel of the cutting tool. Now there are many cutting tools which required different length of travel for different length of travel different 6 screws are mounted here like this and when this turret is rotated, and then this shaft is also rotated by a pair of bevel here. Here you see pair of bevel here and bottom of screw corresponds to the cutting tool in the front. So the length of travel of the tool mount of the front will be decided by the gap between this top and the screw fitted at the bottom portion. So, 6 screws are there of different position according to the length of travel desired. So this is how indexing is accomplished.

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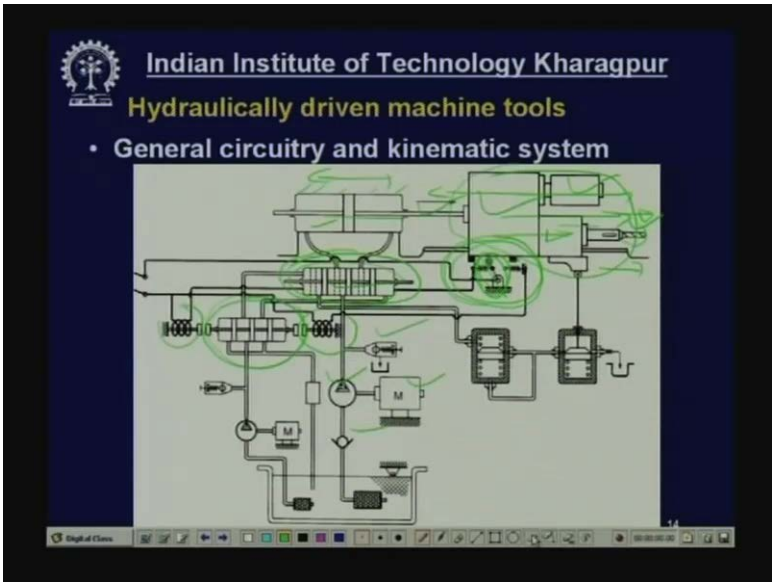

Then come to hydraulically driven machine tools again. We have already heard the advantages and limitations of hydraulic drive. Now let me show you as an example of hydraulic drive because in many automatic machine tools, hydraulic drives are used especially heavy duty. Be acquainted with the general circuitry and kinematic system of a particular machine tool. Say for example, you have taken a drilling a drill. This has to go forward to do some drilling operation. This is the motor this is the gear box and this gives the drill rotation. So speed of rotation is obtained directly from the motor but what about the feed that is the length of travel and rate of travel that will be controlled hydraulically.

Now how this will be done? This unit head drilling head is clamped to the piston. The piston is here which is fitted into the cylinder. The cylinder is fixed and this in the cylinder there are 2 chambers. Oil is pumped by a pump driven by a motor through a foot valve and scale. So this one, there is a relieve valve to control the pressure. It goes through the direction control valve into this chamber. So when the pressure rises here and the entrapped oil here goes out through the exit, then this will move forward feed motion. How long it will go? This will be controlled. The length of travel will be controlled by this stop. There are 2 stops here which will control the location of this pin okay this lever which will be connected here and there.

Now these 2 stops will control the reversal of so this will go forward and will come back depending upon where this valve strikes here or here. Now this direction control valve is controlled by what is direction control valve? Which really hydraulically control the direction of travel of the piston. Now this will be controlled by the pilot valve pilot valve will be control by separately hydraulically by 2 solenoids. These 2 solenoids will be actuated by this stop, electromechanical stop which will control this length of travel as well as the direction of travel. But what about the feed rate but what about the feed rate, at what rate this will travel? That will be controlled by what rate this fluid comes out through this channel flow rate.

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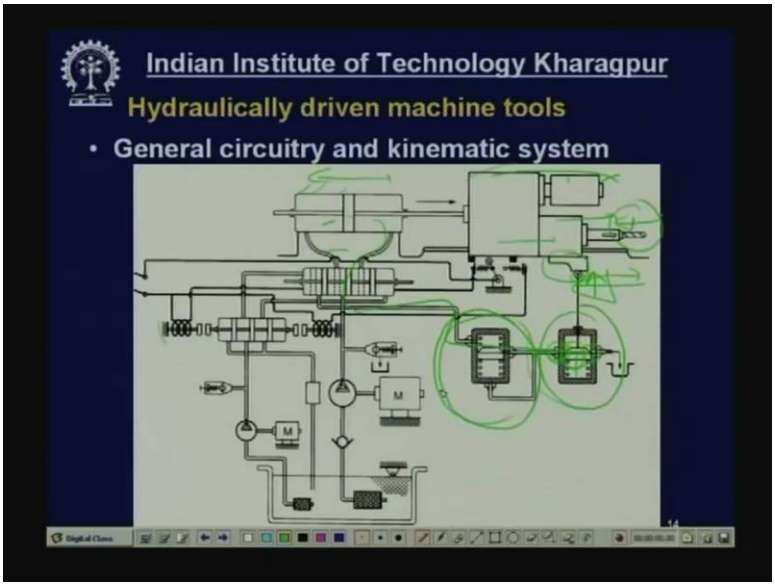

So this is the throttle valve. Through this throttle valve, because of this speed of flow, the flow rate will decide through the throttle valve is the feed rate. Now there is a spool which controls the inlet and outlet that is flow rate. Now this one is the movement of the spool again controlled by this lever. There is a roller actuated by a cam. So when this is moving forward first, then this is moving downward along more opening. So this will go faster. After that this region will force push it up and the opening will be closed sorry restricted. So flow will be slower and the feed will become slow. So quick traverse and then slow feed, slow back and quick return. All these things are controlled. Now the feed rate should be controlled irrespective of the force acting on the drill. For that purpose, a special another valve is used called pressure reducing valve. So this is how all these things are controlled.

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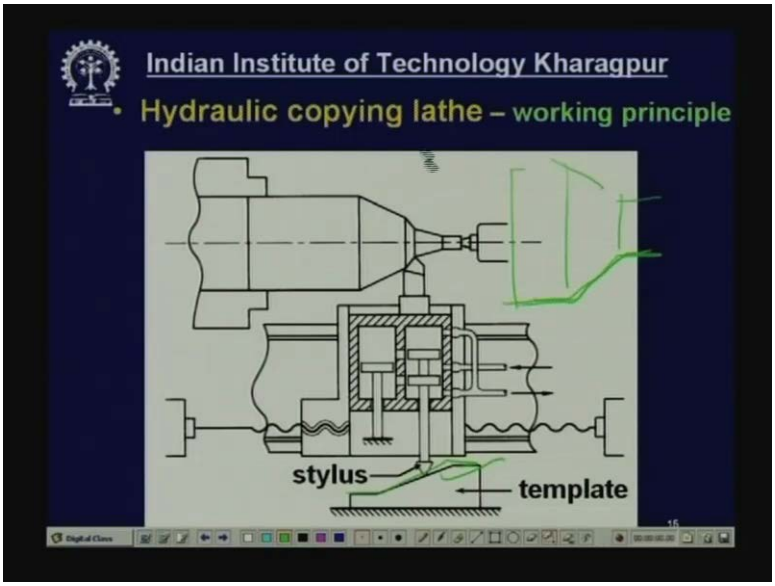

Now come to hydraulic copying lathe. Now the hydraulic lathe; these are mostly used for controlling purpose producing the contour as one example was shown in the handle or lever with a ball and so on say taper. So here is a taper to be cut the straight, then there can be a cut portion and so on lot of things. So this is the hydraulic copying hydraulic copying can be done in ordinary lathe also the use of this attachment. Then we will call hydraulic attachment but the basic principle is stressor control. Now I shall explain. Here this is called template which is mounted on separately outside and this shape or profile of the template will be the replica of the job that you want. Suppose it is like this, that means you will get a job like this. like like this So this end this portion of the job is the configuration of the template, 1 is to 1 all right and so there is a stylus. This stylus controls position of the control. This valve, the spool valve and there is a chamber there is another chamber.

Now when the hot, they have sorry for the high pressure high pressure fluid comes to this passage, these enters into but these two ports are closed. So long this stylus moves along the flat surface straight axial parallel to the axis of the job. There will be no movement in the stylus. So these ports will remain closed. So there will be no oil flow, but when this stylus will because the

screw this lead screw is rotating constantly. So the whole saddle moves at a constant speed along with a tool and the stylus. So when this moves along the slope, suppose it moves from this position to this position, it comes down by a small distance say delta x it comes down the stylus. Now then what will happen? When the spool comes down by a small distance comes down by a small distance the ports open.

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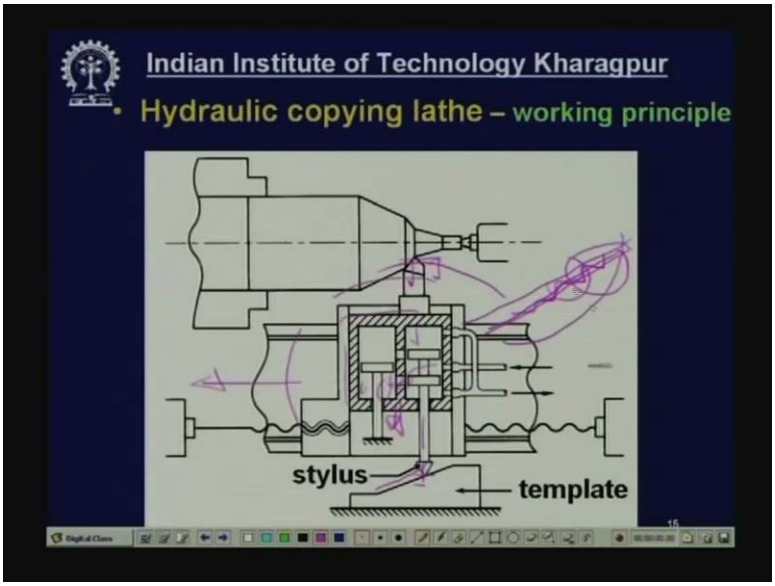

Now the pressurized oil will come through this port and reach here. So this will be high pressure and this is a low pressure. Now because of high pressure since the piston is fixed the cylinder will come down, when the cylinder comes down because of the movement of the stylus, port was opened. Because of the movement of the cylinder, the port will close. As soon as the cylinder also moves by a distance delta x, the port is closed and this movement is stopped. Now, when this cylinder moves down along with the cylinder the cutting tool also moves down. So when this stylus moves by a delta x, the cutting tool also moves by delta x. Then, again it is continuously moving down so the slope will like this it will move like this it will go like this. Come down go straight, come down go straight. As a result effectively this will be a taper surface and these incremental distances are very small delta x delta y. So it is basically a straight line or may be a curved line. This is how copying is accomplished.

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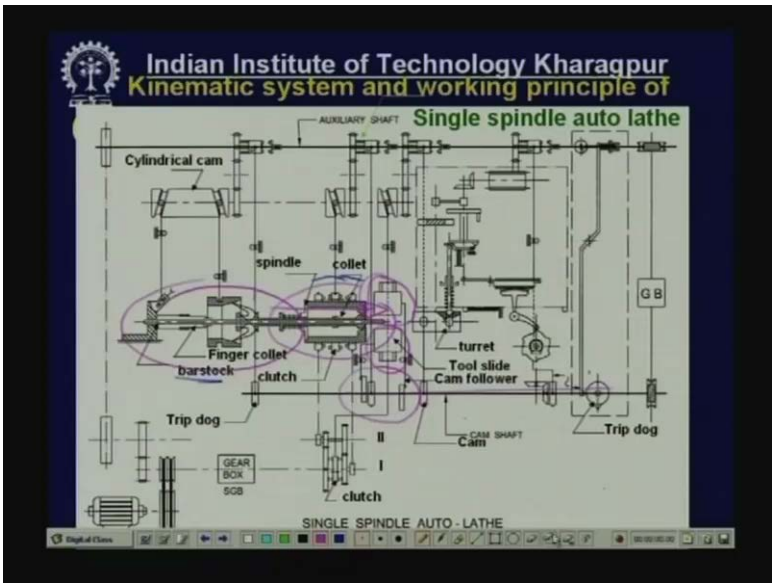

Now this looks very complex but not really that complex kinematic system and working principle of single spindle automatic lathe. As I told you that automatic lathes are machine tools are very popular while they used for mass production, lot production and lathes are very much more popular and widely used among so single spindle automatic lathes are most widely used amongst all automatic say machine tools say conventional type of machine tools, general purpose is a general purpose. Now so to utilize or exploit this machine tool to advantage the workers, operators and designers manufacturers everybody should be conversant with the kinematic arrangement of this machine tool.

Now what are the basic features? As I told you the basic modules of this machine tool, let us list that first, one is the spindle speed. This is the job, this is the job rod like all right this is the barstock shown over here which has to be rotated, be mounted in the spindle. So the rotation of the job into the spindle that is one work. Next one is the job has to be fed that is called bar feeding. So this bar this rod has to be fed time to time that is called bar feeding mechanism bar feeding mechanism. Third will be the cutting tools the rear front cutting slide, rear slide, vertical slide and other two inclined slides 5 slides have to move radially and they have to be done accomplished by cams and the cams are mounted on a shaft called cam shaft okay and then this turret. Next important module is the turret.

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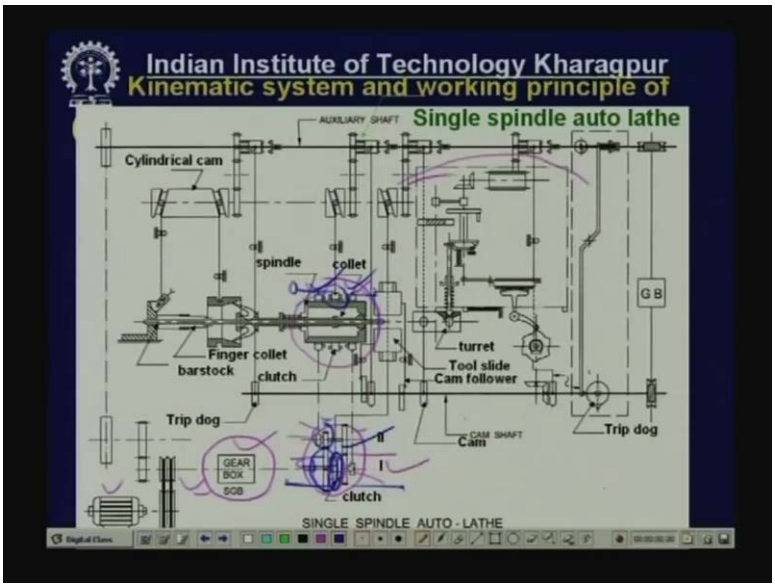

This turret which holds cutting tools on 6 surfaces have to be indexed moved forward and backward for the cutting action and it has to be indexed and this is the indexing mechanism. Now let us discuss one by one. First of all the power comes from this motor to these gears through a gear box and belt pulley system. Now as I told you since its mass production machine single spindle automatic machines are multi spindle lathes, they do not require many speeds, because same job is done with the limited diameter and so on. So it may be 2 or 4 speeds. These are not very important but here you can see, the speed comes into the shaft number one and there are 2 gears loosely mounted on the shaft and they are connected to 2 more gears on the shaft number 2 and there are 2 sprockets on the 2 shafts two gears, and this from this sprockets speed goes into the 2 sprockets here which are mounted on to the spindle. But remember you see that these 2 sprockets are loosely mounted that is even if they rotate, the spindle will not rotate.

Now these 2 gears are also loosely mounted. So these 2 gears will not rotate until the clutch inside there is a clutch inside. When the clutch is move leftward or rightward then, either this gear or this gear will be engaged and this rotation transmitted to this gear and this gear which rotates at same speed. So these 2 sprockets loosely mounted on the spindle will keep on rotating at the same speed, magnitude of speed but in opposite direction, but spindle will not rotate until the clutch is moved leftward or rightward. So now again when this clutch is moved leftward, you get high speed because the speed it transmitted from big gear to small gear. So speed of these 2 gears will be high, speed of the spindle will be high and when this clutch will be engaged in the small gear, this on right hand side because of the smaller reduction the speeds of the spindle as well as these sprockets will be low. So what we understand that by operating this clutch, we change the magnitude of speed, by operating this clutch left right left or right we get clockwise or anticlockwise speed.

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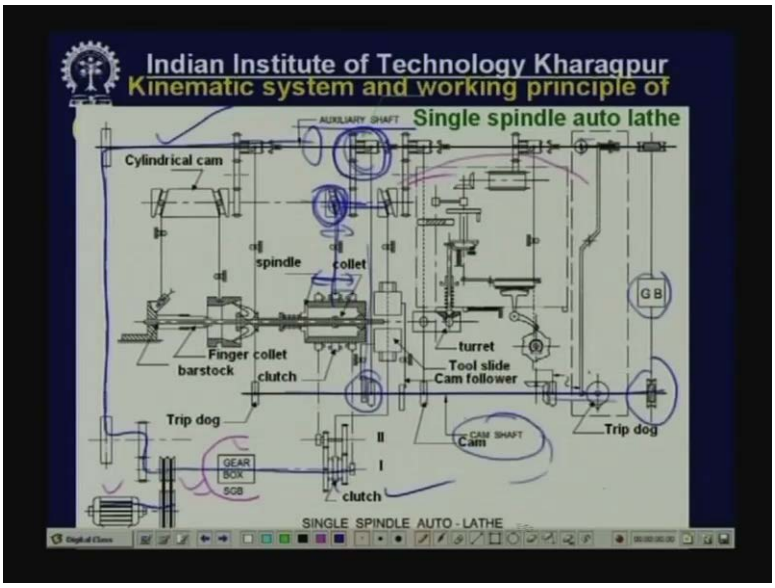

Now these clutches are moved forward or backward like this with the help of a lever. The other end is fixed into a cylindrical cam. When a cylindrical cam rotates, this moves here and there. So this is transferred here. Now this cylindrical cam has to be rotated by a shaft. Now before that let me again tell you that power comes from this motor, goes to this shaft. It also goes to another shaft. This shaft is called auxiliary shaft which rotates continuously constantly at 20 RPM and from this shaft, the power is coming through a gear box and through reduction mechanism into another shaft called cam shaft which rotates very slowly and one cam shot rotation means one job. Now this is how this is done and this is the shuttle rotated by a single revolution clutch which transmits rotation only one revolution from this constant speed called this auxiliary shaft to this shaft. Only one revolution and this clutch is actuated by another trip dog which is mounted on the cam shaft.

Now next is bar feed mechanism. In bar feed mechanism, the collet has to be opened. Now when this push tube this one is moved in this direction by this lever, this collet will be open. The job will be free and then this lever will move in this direction. Push this rod in the forward direction with the help of this finger collet. After that, this will rotate the next half and this will move in this direction and the collet will be closed. Job will be held tight and this will move back keeping the job feed this slide will come back by sliding. So this way, this bar feeding is accomplished. Now come to the turret indexing; the turret indexing here. This turret has to be moved forward and backward that is done by a cam. Why there are 6 lopes? The rotation of the speed of this one and this one are same cam shaft and this shaft as same by 1 is to 1 and they are 6 lopes to move this turret, you know 1 by 1 for the 6 cutting tools.

So the configuration of this depends upon the length of travel, rate of travel, direction of the travel of the cutting tools. Now for indexing purpose, this pin has to be withdrawn that is done. First of all, this shaft has to rotate. When this shaft will rotate, this pin will enter into the slot of the general mechanism. So this will rotate slowly and before that the speed will be withdrawn this locking pin. This locking pin will be withdrawn and so it is free to rotate. Now this one will

be rotated by this pin and then it will be locked again by this pin. So this is how turret indexing is accomplished.

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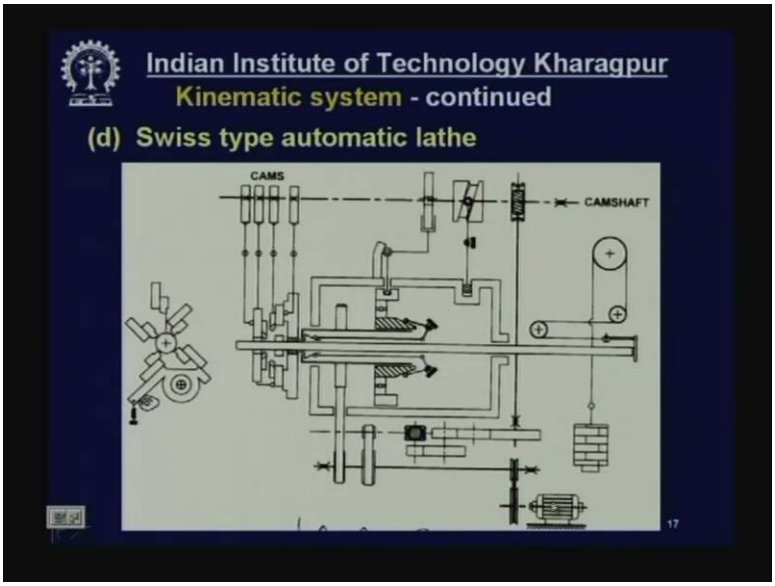

Now this is Swiss type automatic were this is the bar which is held by a collet here, that is called stationary collet operated by a push tube. Now the power comes from the motor through the shaft and it goes to the spindle. So the spindle rotates along with the collet and the job in this direction and then, this power comes into this cam shaft which rotates very slowly. Now when the cam shaft rotates this cylindrical cam moves this entire headstock along with all these things forward through the tool job guide the bush against the cutting tools all five cutting tools which are actuated by 5 cams or 4cams and then which are mounted on the cam shaft and when the job will be complete, then the collet will open and under gravity the rod will be pushed, it will be arrested by a tool and again this will be and this will be repeated.

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Now next is process planning and tool layout for machining a job in automatic and semiautomatic lathe. There are certain procedure steps in sequence. Now what does it mean that a job has to be machined in large number say 2000 pieces. So you have to make a process planning, select the cutting tools machine tool and the blank and then tool layout all these things. What are the steps? Thorough study of the job to be produced in respect of volume of production that how many pieces have to be produced. Material size and shape shape means circular or regular polygon size, the diameter, number and types of surfaces to be machined the amount of work necessary, machining work, required dimensional accuracy and finish and end use of the product. All these things will help selecting the machine tool, selecting the cutting tools, selecting the blank, and arrangement of the cutting tools and positioning all these things.

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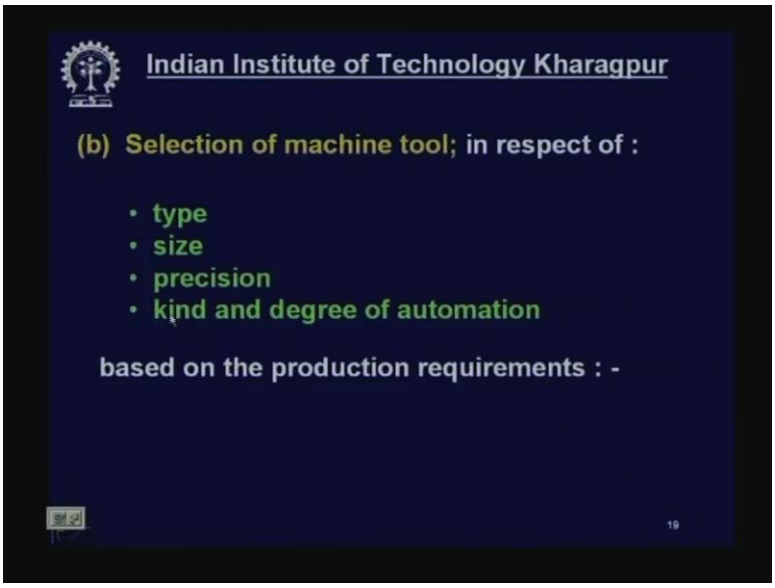

Now selection of the machine tool: this will be in respect of type what kind of machine tool automatic, semiautomatic or non-automatic size, heavy duty precision or non precision kind and degree of automation that is what kind of automation and degree of automation. All these things to be decided by the production, production requirements. What kind of job how many pieces are to be produced?

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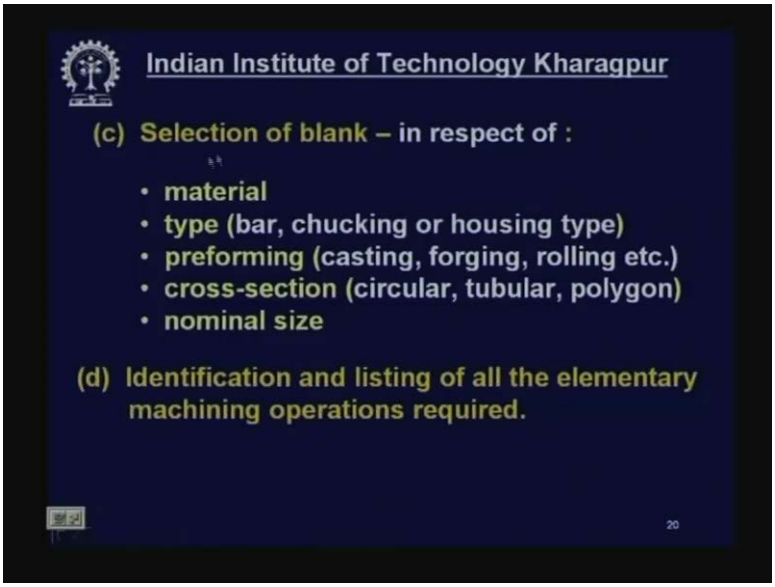

Next is selection of blank that depending on this in respect of material type, bar chucking or housing type, pre forming should be casting, etcetera then identification and listing of the elementary machining operations to be required. This is the most important part.

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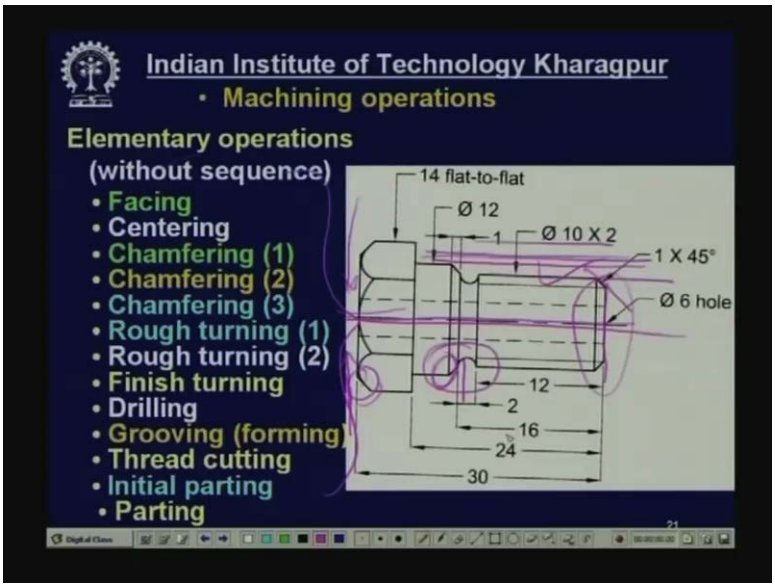

Suppose here is a job okay. Now this job has to be done large number of pieces and you have to identify what are the machining operations you have to do. Say for example in this case, the facing, chamfering, drilling, then turning rough turning, then second rough turning, finish turning, this grooving and then then this chamfering. This chamfering say partial or initial parting then thread cutting then final parting. So all these operations have to be identified irrespective of their sequence so all these operations have been listed here this way it has to be listed then next step will be combining this work has to be combined. So that, the total time can be reduced. Say for example facing and chamfering can be done together by 1 tool then chamfering and grooving this chamfering and this grooving can be done by 1 tool then paralleling say while doing this rough parting rough turning this rough parting and the chamfering can be done simultaneously then this rough turning drilling and centering can be done simultaneously. So this way by overlapping and combining operations ah you can save lot of time.

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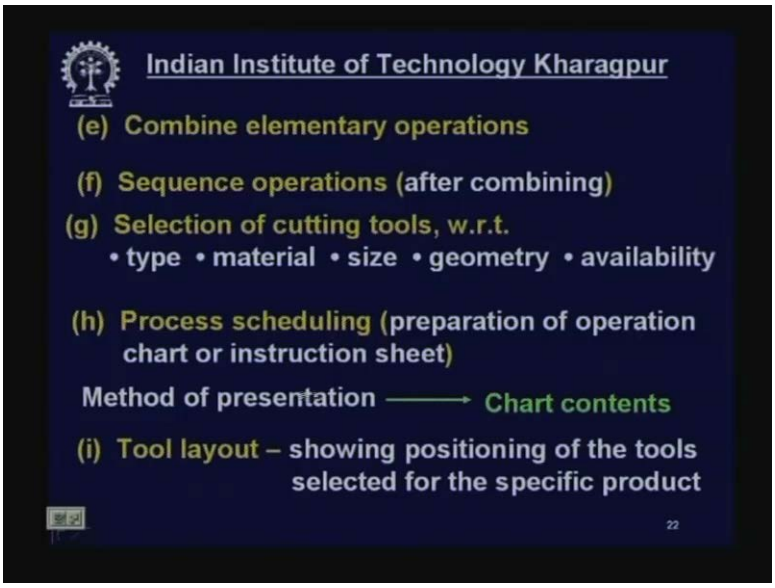

Now the combining operations all these things; Now next comes the operation chart has to be produced. Process scheduling a process chart has to be produced containing all the information that what are the operation sequence, what should the cutting tool corresponding, what should the position of the cutting tools and so on say tool layout showing position of the tool layout.

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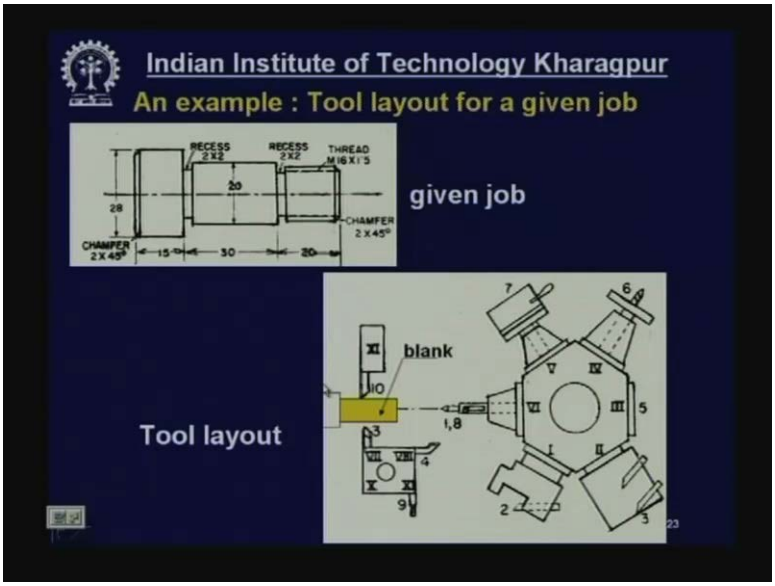

For example, if this be the job to be done in a large number, then this will be the corresponding tool layout say this is the turret, there are 6 cutting tools and a front slide may be two three four cutting tools and the real slide one and there may be vertical tools also.

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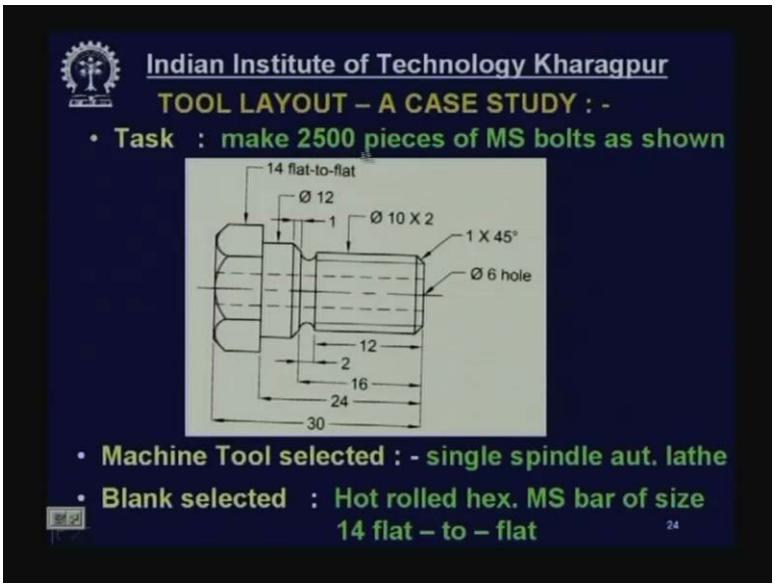

Now after completing this thorough understanding, you can now do it yourself. Say tool layout a case study. This is the task. Suppose you have to make 2500 pieces of mild steel bolts of this kind with all dimensions are given material is mild steel number is 2500 pieces. So it is say mass production very large lot production. So automation is required and it is a bar type, so single and lot of machining work has to be done. So single spindle automatic is appropriate, so machine tool selected will be single spindle automatic lathe blank selected. Now there is a hexagonal head, now this hexagonal head can be made later on or if you take a hexagonal bar in advance then by machining the hexagonal bar you need not machine the hexagonal head this will automatically obtain. So hot rolled hexagonal mild steel bar of size 14 this is the size the hexagon is decided by flat to flat all right the flat to flat 14. So this way you can do the entire operations elementary operations you can identify.

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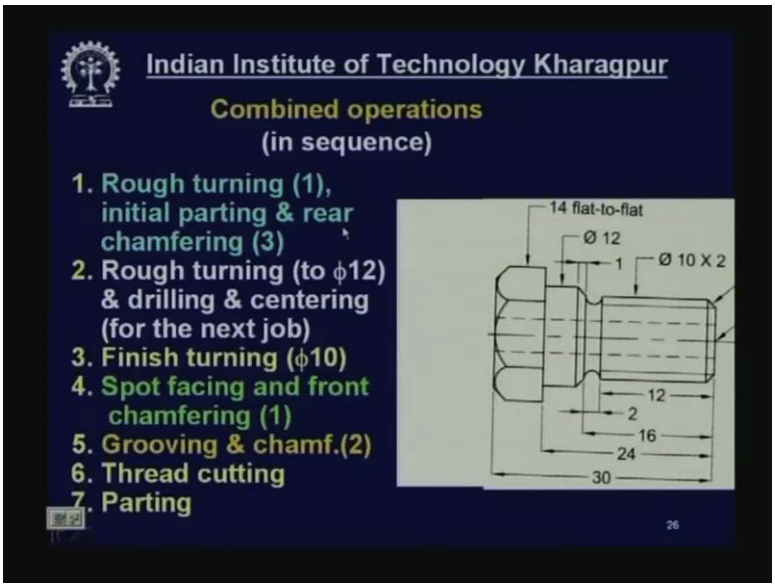

Then you combine the operations as shown over here. Then you just write the sequence operation number one rough turning, initial parting, chamfering together, then rough turning, drilling and centering together finish turning only alone spot facing and chamfering here alone here grooving and chamfering here together thread cutting here by a solid die and parting finally alone.

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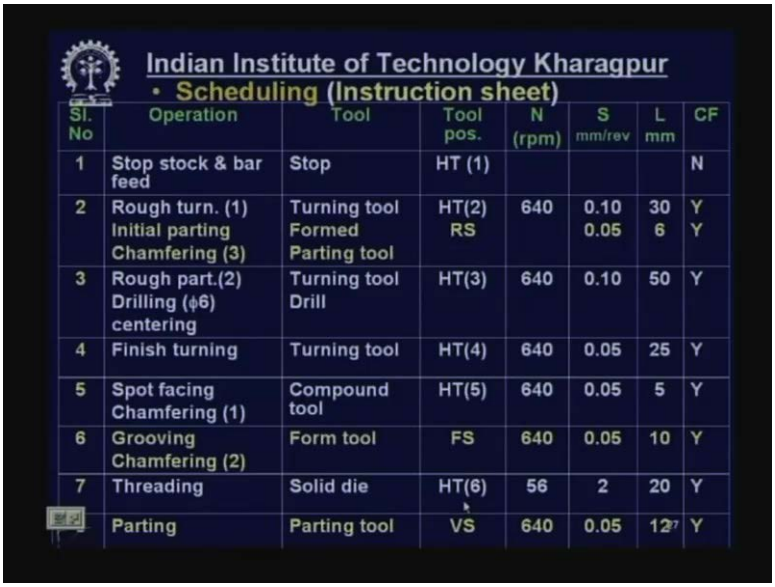

Then you prepare this chart. Showing the position of the tools say hexagonal turret phase 1,phase 2, phase 3, phase 4, phase 5, phase 6 and the cutting tools like this tools pump tools rear slide front slide and vertical slide and this is the corresponding tool layout.

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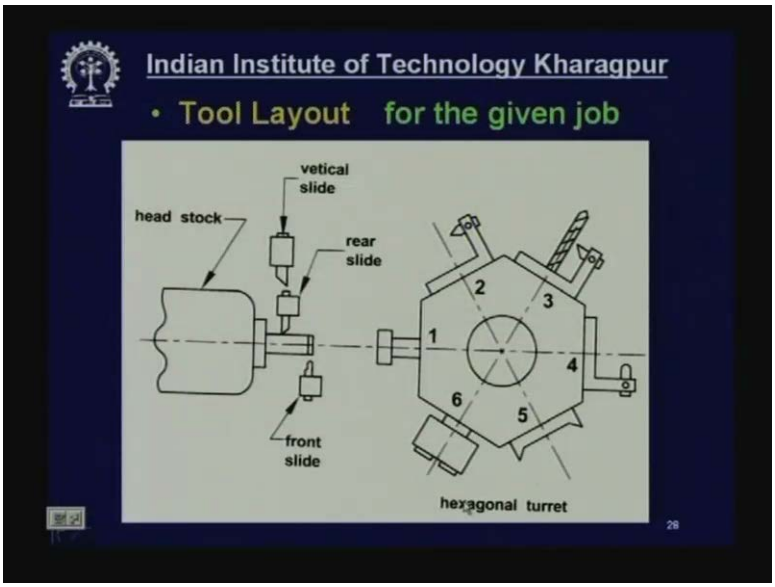

Now this way you can practice and you can do lot of exercise with all understand.

Thank you.

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Good afternoon. Young friends you are welcome to our course Manufacturing Processes – II.

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The module that is continuing General Purpose Machine Tools and today's lecture topic is use of various attachments used in machine tools.

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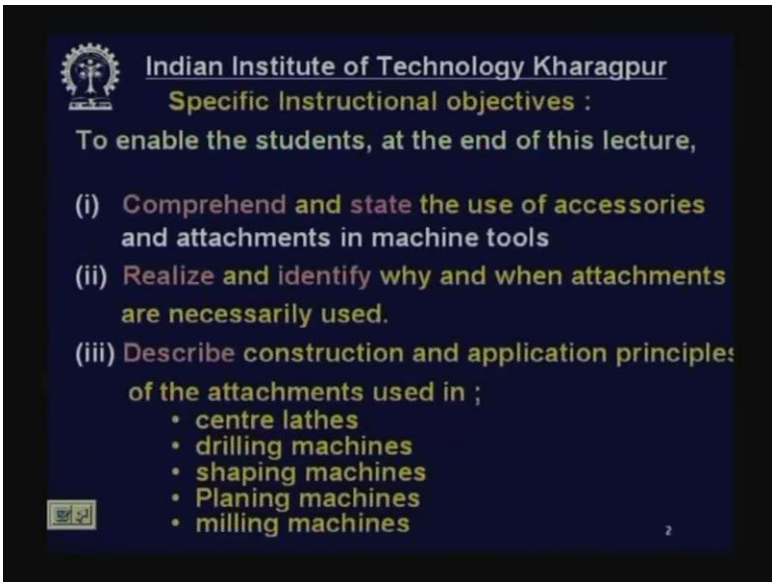

Now what are the objectives today? This lesson will enable the students comprehend and state the use of accessories and attachments in machine tools. Second realize and identify why and when attachments should be used or necessarily used and third describe, construction and application principles of the various attachments used in centre lathes, drilling machines, shaping machines, plaining machines and milling machines which are most conventional general purpose non automatic machine tools.

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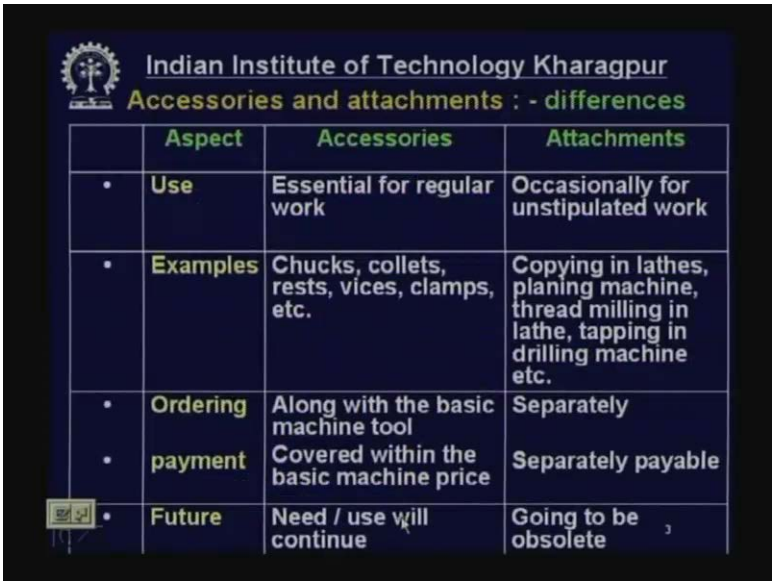

Now let us see a bit quick glance into accessories and attachments, accessories and attachments both are used in machine tools. But there are differences. What are the differences between

accessories and attachments in respect of use accessories remember these are essentially used for regular work. You know each machine tool is specified for a range of activities is called stipulated work and for conducting the stipulated activities, some devices extra devices are to be incorporated to the machine tool but in the attachments which are very occasionally used and beyond the stipulation range. You want to suppose a lathe has got some stipulation. You want to do something which cannot be or should not be done in lathe. But we shall do it in a lathe deliberately with the help of an attachment is very occasional. Examples of accessories which are inevitable for regular work chucks, collets steady and follower rests different types of vices clamps and other things in different machine tools. What about in case of attachments? Say copying in lathes plaining machines, now you are doing copying milling machines, plaining machine with the help of certain attachments as and when required. Thread milling; so you are doing milling in lathe, tapping in drilling machine. So these are various attachments which are very occasional used when you know almost compel