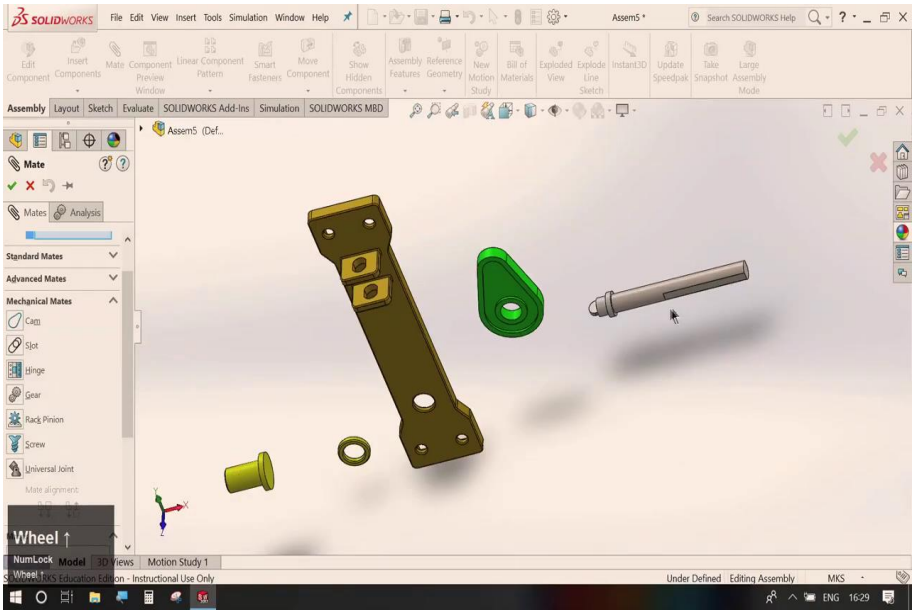
Engineering Drawing and Computer Graphics
Prof. Mr. Gaurav Singh
Department of Mechanical Engineering
Indian Institute of Technology, Kharagpur

Lecture – 65
Assembly Drawing (Contd.)

Hello everyone. In the last lecture, we have covered up to this advanced mates. Now, in this lecture, we will go about mechanical mates available in solid works. In the mechanical mates we can see here the cam mate, slot mate, hinge gear, rack and pinion screw and universal joint.

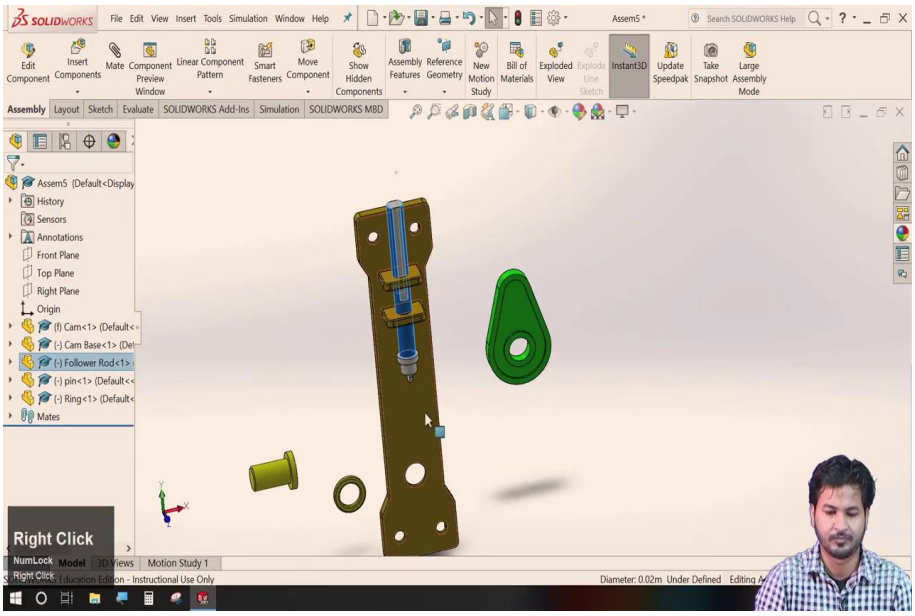
Out of these, we have already covered hinge mate and gear mate. So, now, in this lecture, we will start with this cam mate. So, for this cam mate, I have loaded one this some parts you can see here.

(Refer Slide Time: 00:47)



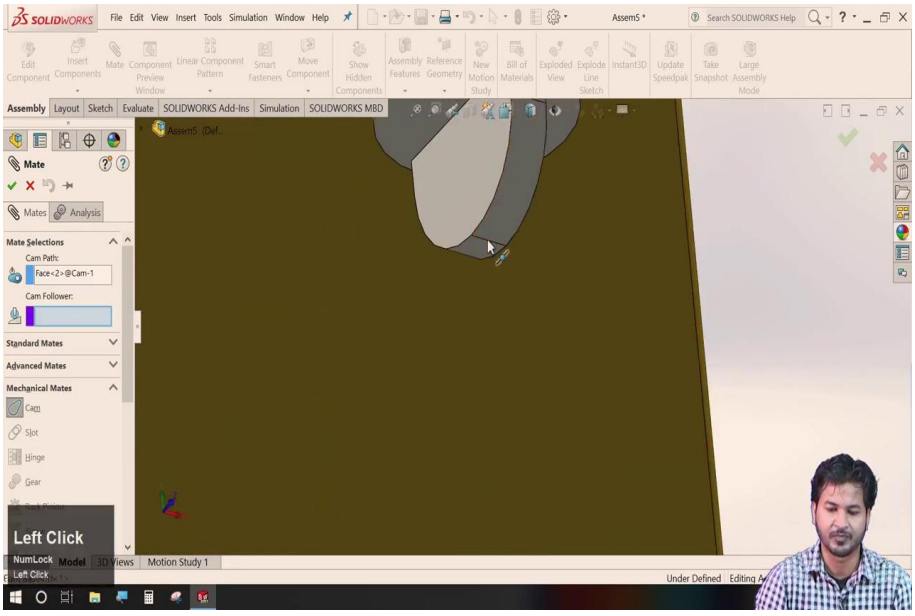
So, this particular part is called as cam, this is cam surface and this is a follower for this.

(Refer Slide Time: 01:04)



Let us just assemble we will fix this follower onto this.

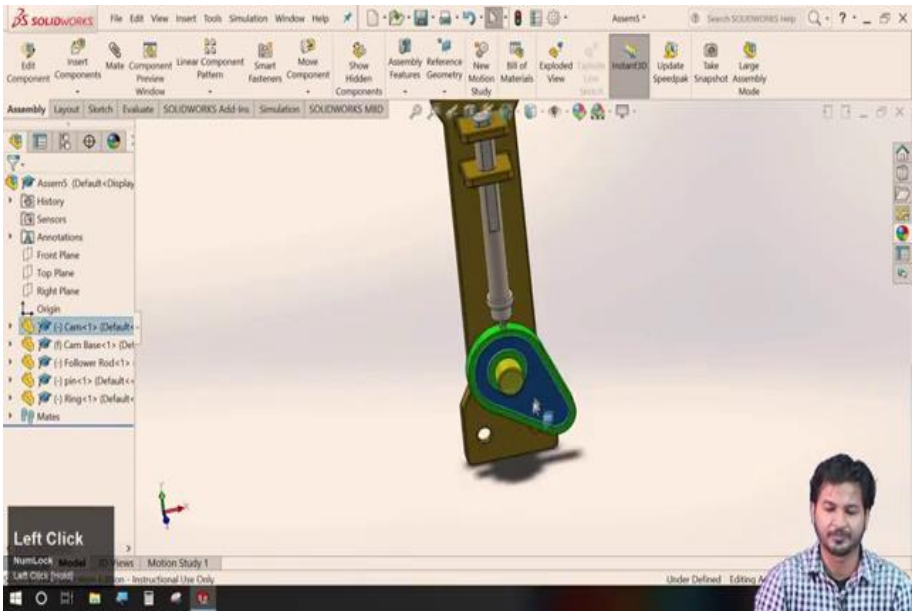
(Refer Slide Time: 02:57)



So, now here we have this cam that is rotatable rotate that can be rotated along this shaft. And we have a follower that can move over here, these type of cams are generally used in piston-cylinder engines that are generally used to open valves.

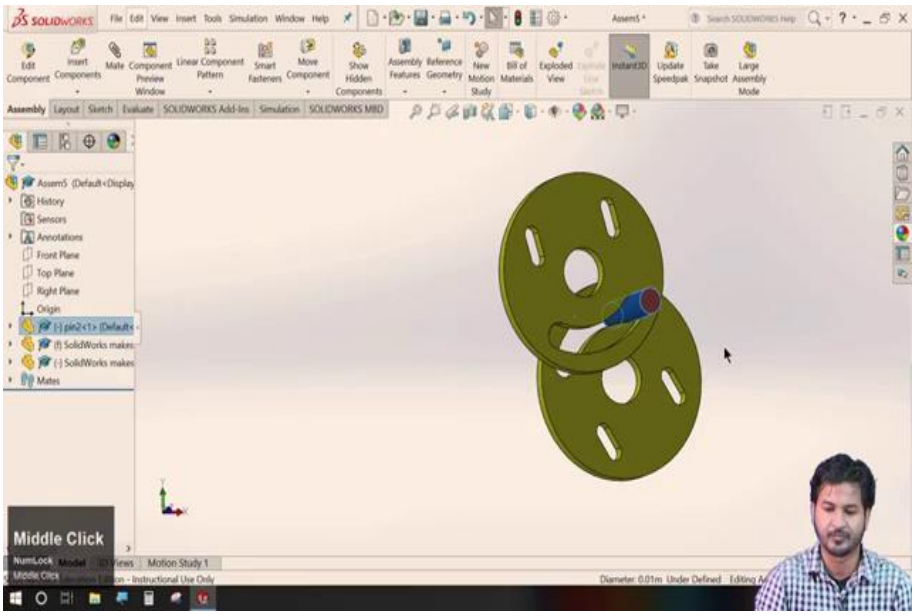
So, in the cam mechanism we will go to mate, then mechanical mates this cam follower asks of the two things that are cam path that is supposed to be this surface and the follower. For this follower, the point that has to be lying over this cam path, let us just select the centre you click ok.

(Refer Slide Time: 02:57)



So, now we can see as we rotate this you can see, this follower is attached to the surface of this cam. So, here helps this cam mate. So, this was cam mate available in mechanical mates. So, the next one is this slot. So, for that we will load some other geometry let us just remove these I will insert component.

(Refer Slide Time: 04:24)



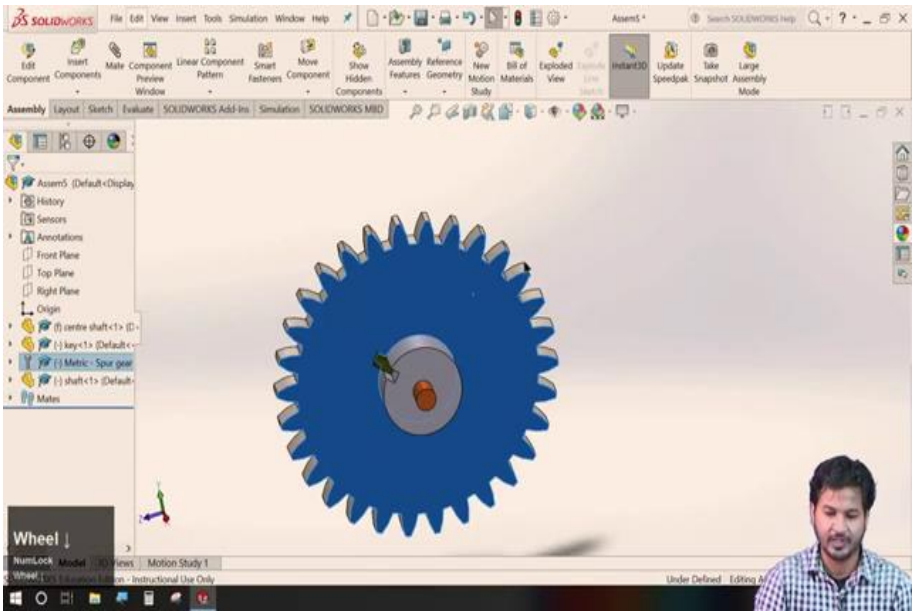
Here, I have this component with a smiley face kind of thing. And we will make let us just make a copy of this. So, this part has a slot into it. So, this slot allows us to align the slot the two slots or a slot or a pin to one another. Let us just check this we will go to mate, this mechanical mate then this we will select a slot.

So, for this slot, we need to make the two selections that are slot and this slot. So, this slot is now fixed over other. So, let us just let us fix this one and we can see this moves as in line with the other slot. So, just to make it better we will just attach both of these. So, here you can see the slots of both of these are aligned to each other and they roll over another surface, we can also fix a pin into this.

Let us just go to mate again we will select slot, we will select two items say this surface and this pin. Now, you can see this pin is fixed into this and this pin can also move on to the slot, this was slot mechanism. So, the next mate available here is the hinge mechanism that we have already covered, we have already covered; now we will go about this gear mate.

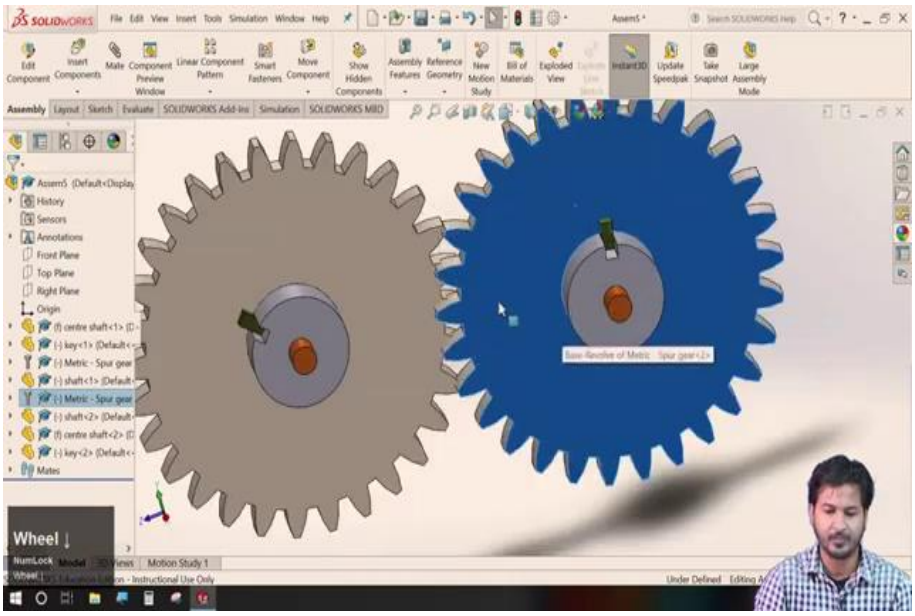
Let me load just some of the parts for gear mates.

(Refer Slide Time: 06:45)



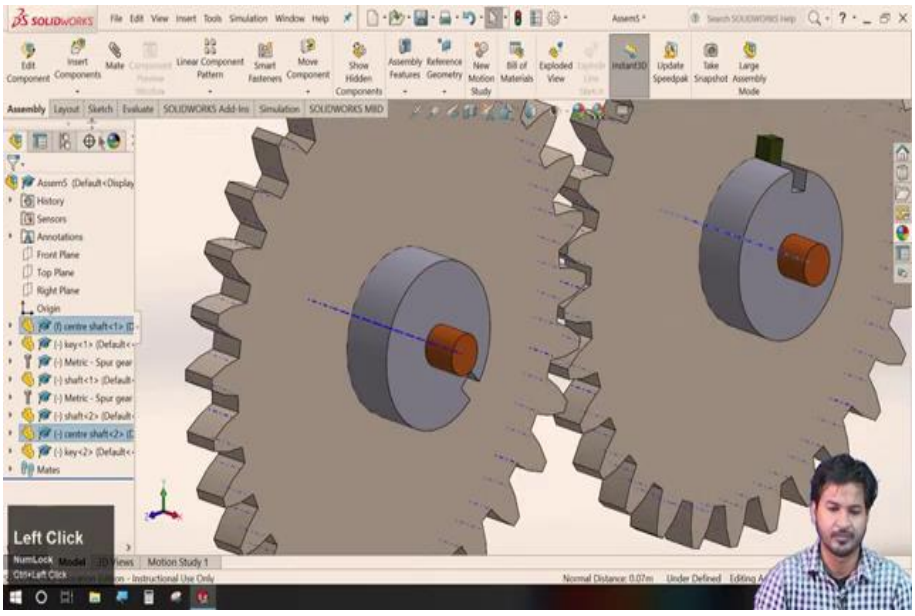
Here we have this gear and there is its housing. So, let us just set up this housing first. So, I will be little quick while this assembly please follow; so, here we have this one spur gear rotating about this axle.

(Refer Slide Time: 09:07)



So, we need another of those. So, I will copy make a copy of this and once again the same procedure is done.

(Refer Slide Time: 10:58)



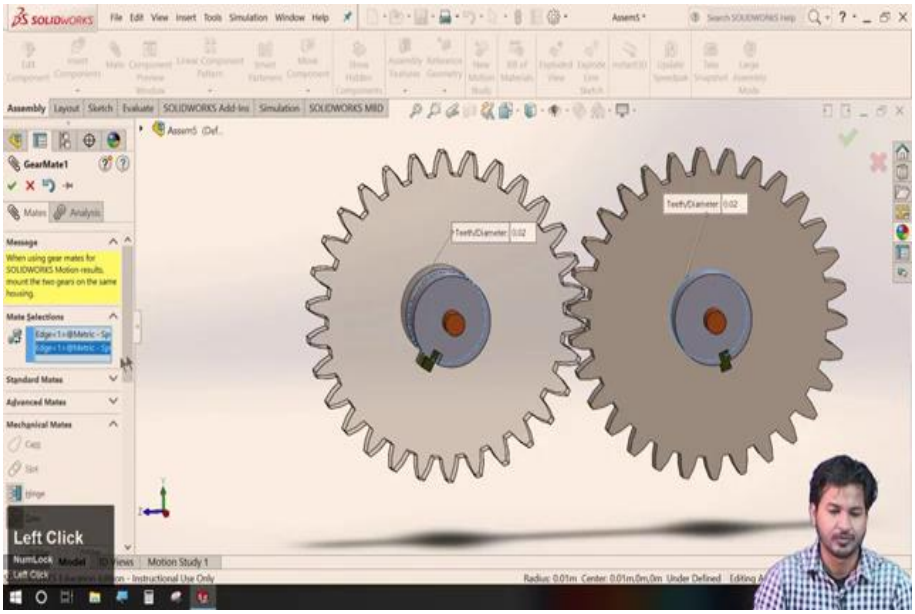
So, here we have two gear setup I will just make it floating we can move over here. So, what we intend to do is to align this rotation and this will impact the rotation of the other one for this, we have to set up you know them in a plane for that. So, we will select these two faces we will click on mate and we will align this as coincident click ok.

So, now, both of these are in a single plane to make it as a constant distance, we want this to be fixed at a constant distance. So, for this, we will go to so axis. So, the axis of these two axles we can mate. Now, here it coincides so, they will be coinciding with each other, but before that, we have to select these place them at an appropriate distance.

So, we will align them very nicely you can just take your time we will align in this way. So, now, again we will coincide the centre shaft and here we have this offset will click and it will automatically restore to its previous position and lock that. Now, it is we click on ok we will hide the axis.

So, here we have we can see this moving because this shaft here is not fixed. So, we need to fix it let us just place it well and we will fix the shaft. We can see this moving and also this one, however, there is no relation as of now. So, this relation is featured by this gear mate available in mechanical mates we will go to mate, mechanical mates just remove the selection.

(Refer Slide Time: 13:40)

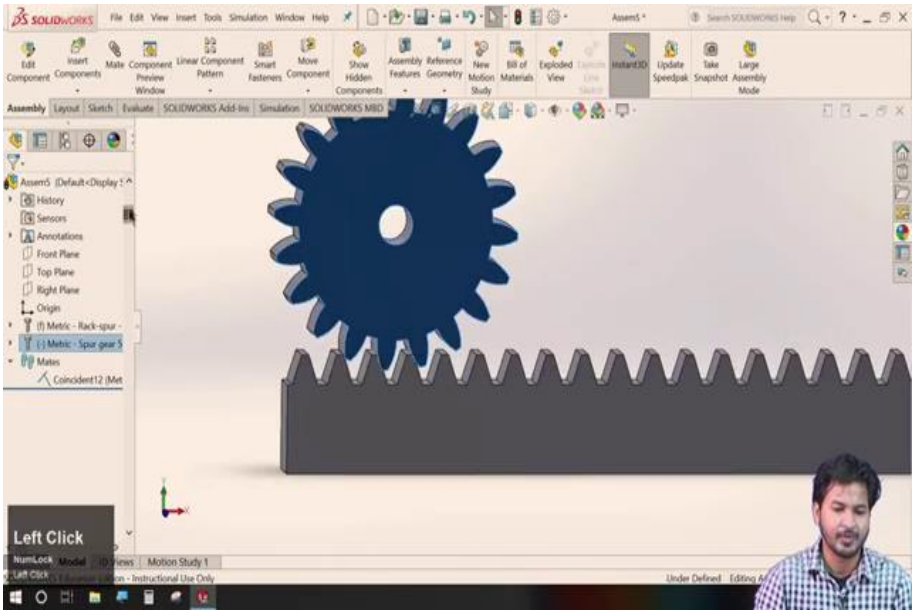


And in the gear mate, we will select the two radii say this and this. So, this gear mate automatically detects the ratio between these two, it has detected the ratio between the gear and the pinion and as you click ok it will link it up.

So, as we are moving this gear in the direction it is automatically transferred over to the other one. So, similar is the other case; however, in this case, we can reverse this direction, in case of maybe epicenter gears and others. However, we can reverse these directions so, we will go to at we have we can see here an option called reverse.

So, which check now; so, both are both of these are moving in the same direction. So, this is gear mate so, the next mate we will discuss now is rack and pinion for that I will be loading one geometry insert component, I will just load rack and a pinion.

(Refer Slide Time: 15:06)



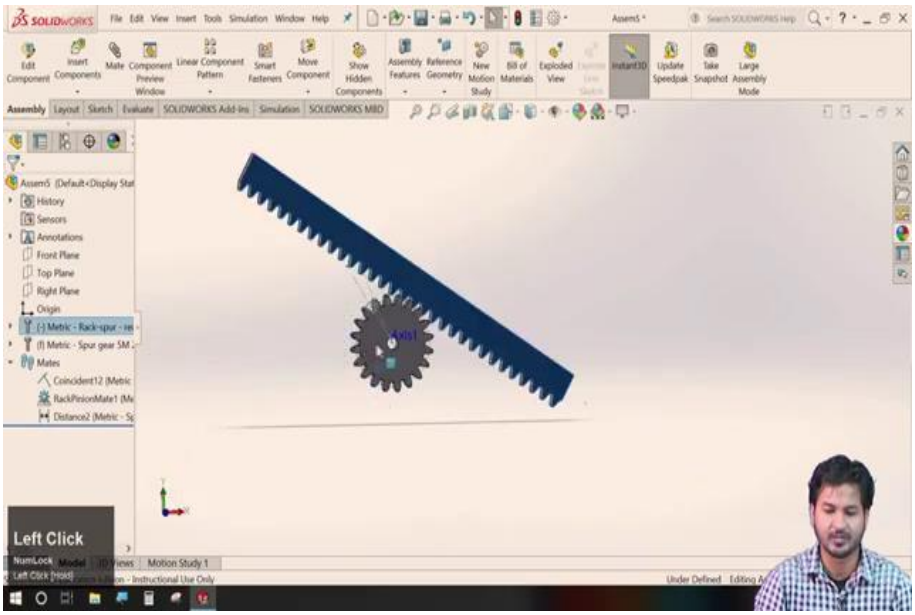
Here we have this rack and this pinion over it. So, this rack and pinion allow, this rack and pinion intend to this as the motion of this pinion will translate this rack, these are generally used in conveyor belts. So, let us just set up this rack and pinion, I will just align these over one another. So, for this rack and pinion, I will go to this mechanical mate.

Now, I will select rack and pinion so, first, this asks for this to select the rack length. So, for this rack, I will just select the last edge of this rack. And for pinion it is best to select the pitch diameter for this; however, we cannot see the pitch diameter as of now to see that we will do one thing, we will just we will go to the part details and we will select this tooth cut will make it show.

So, now you can see the tooth cuts of this pinion we will align this. So, now, again we will go to this rack and pinion mate. So, now, we can we again select this rack and this pitch diameter I will click ok. However, this can move in other directions as well.

So, for this we need to fix this axis this we can see this, this can move in an upward direction. So, to fix this we need to lock this into this position. So, for that, I will nicely align these two as we have done in this gear thing.

(Refer Slide Time: 17:47)

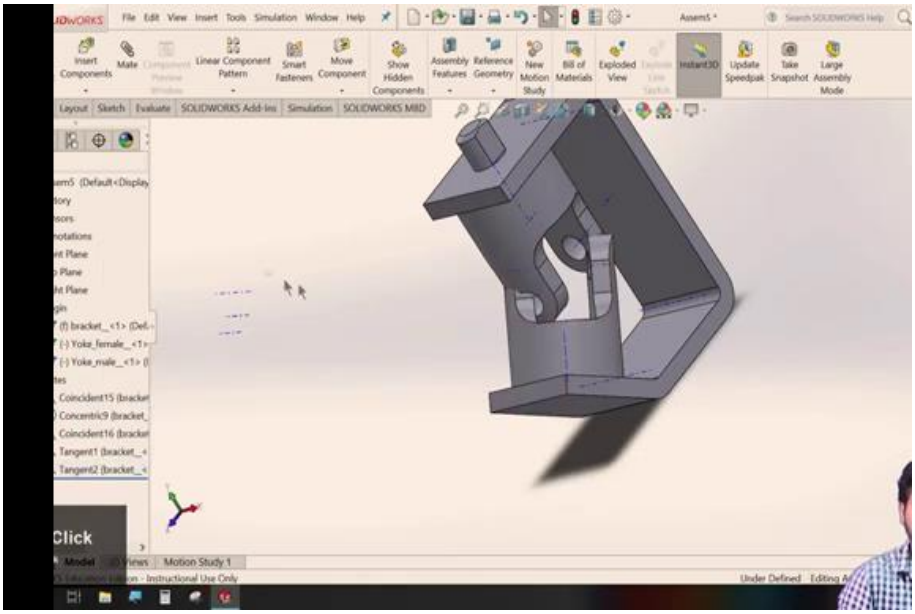


So, now we will select we will ask for to show the axis, we will select this axis and base of this mate we will make it coincident and at an offset.

So, now, as this pinion moves forward you can see this rotating, if we lock this and we will move this rack we can see this rotating; so, now, if we move this pinion. So, now, if we move this pinion we can see this rotating we can also reverse the direction like in gear assembly.

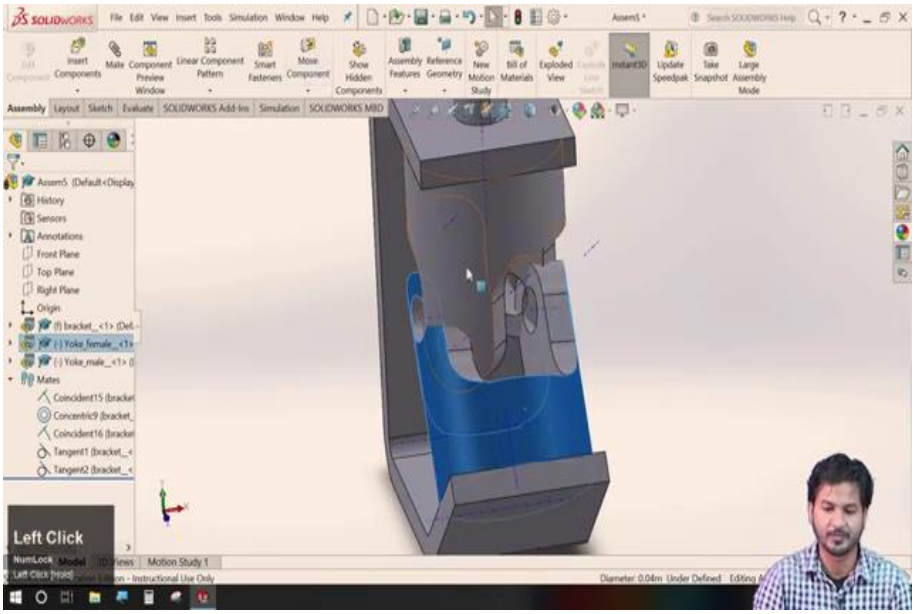
So, this was a rack and pinion motion. So, the next available mechanical mate here is the screw, this screw we have already covered now we will check this universal joint. However, this is not very frequently used in assemblies, because there are many roundabouts too for doing that. So, let us just for just the demonstration, we will just check this.

(Refer Slide Time: 19:20)



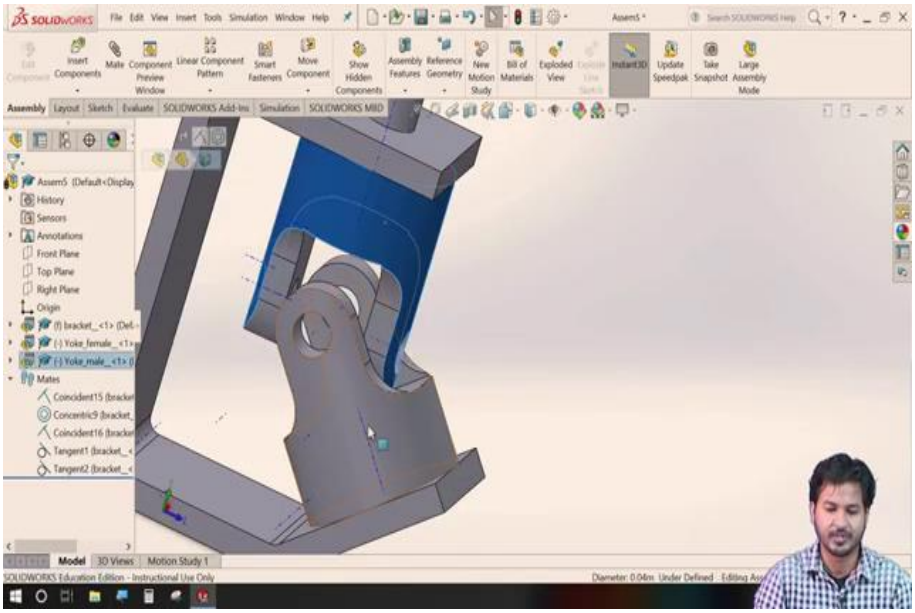
We will go to universal joint we will import some parts; I will assemble this these for setup just click.

(Refer Slide Time: 20:26)



So, here we have these two carbs shaft couplers this is generally called universal joint.

(Refer Slide Time: 20:36)

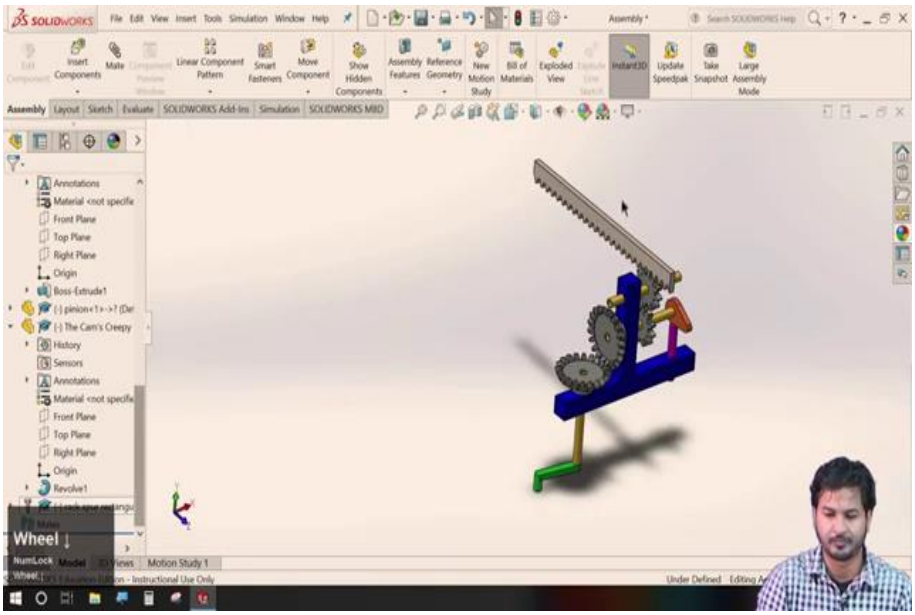


So, what we require is to align the motion of this to transfer these to this particular shaft, for that we will, first of all, align this nicely.

Now, I will go to mate then the mechanical mate and to the universal joint, we will select the two bodies this and this click ok. So, now, you can see as we rotate one of these the other shaft is all coupled to it and moves nicely. So, this is universal joints.

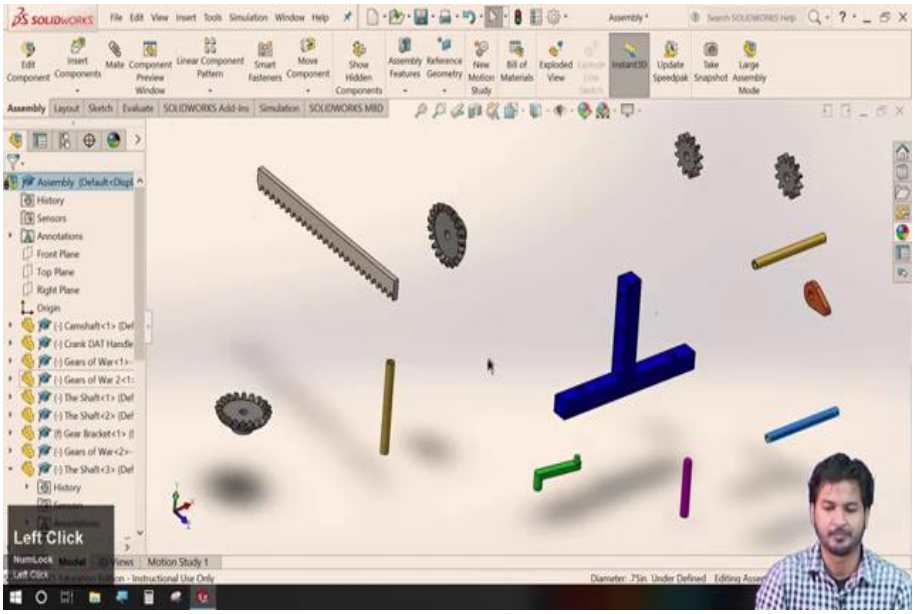
So, now we have finished all the mates available in mechanical mates, we have also covered these advanced and standard mates in previous lectures. So, let us just revise these mechanical mates, we will work around a simple assembly that will feature some of these popular mates.

(Refer Slide Time: 21:58)



So, we will insert an example problem.

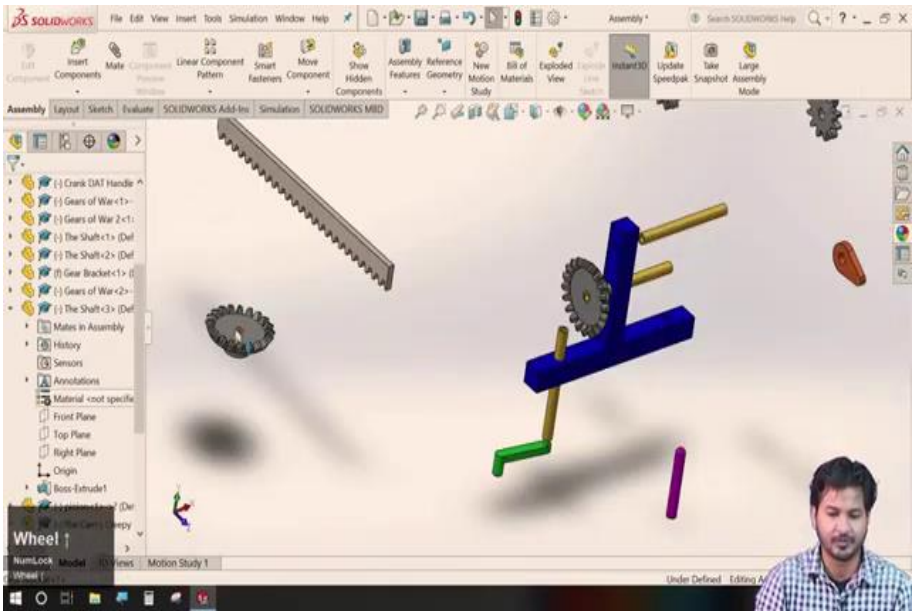
(Refer Slide Time: 24:09)



Now, in an example problem, we will look for the recently learned these mechanical mates available. So, I have loaded this certain parts that would feature the mechanical mates that we have recently learnt.

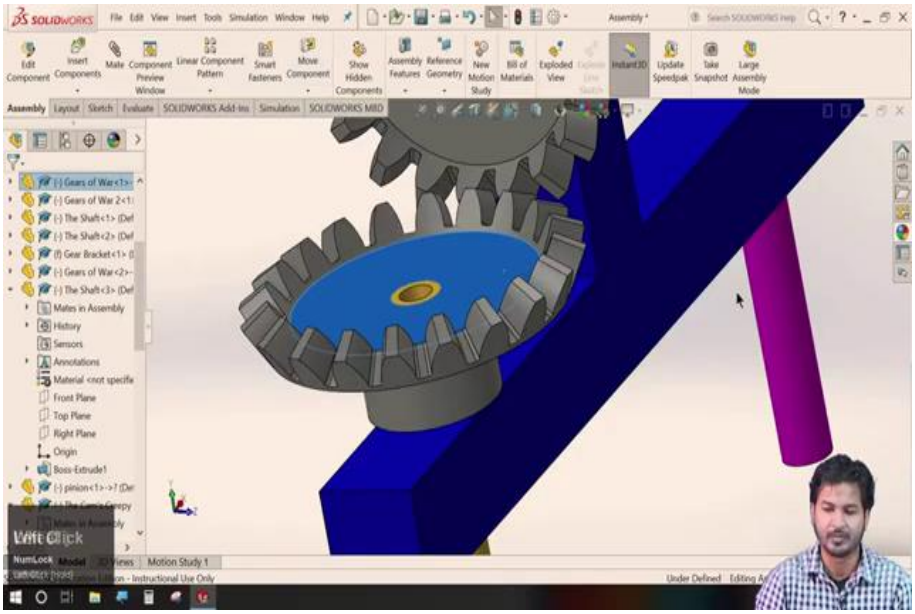
So, let us just try to assemble this as a demonstration. So, here we have is a chassis. So, that fit mounts all the racks this is a rack, a pinion, a bevel gear, shaft cam and shaft. So, we will just quickly finish it up we will fix this rod here.

(Refer Slide Time: 25:28)



We will set up this bevel gear, now the counterpart for this.

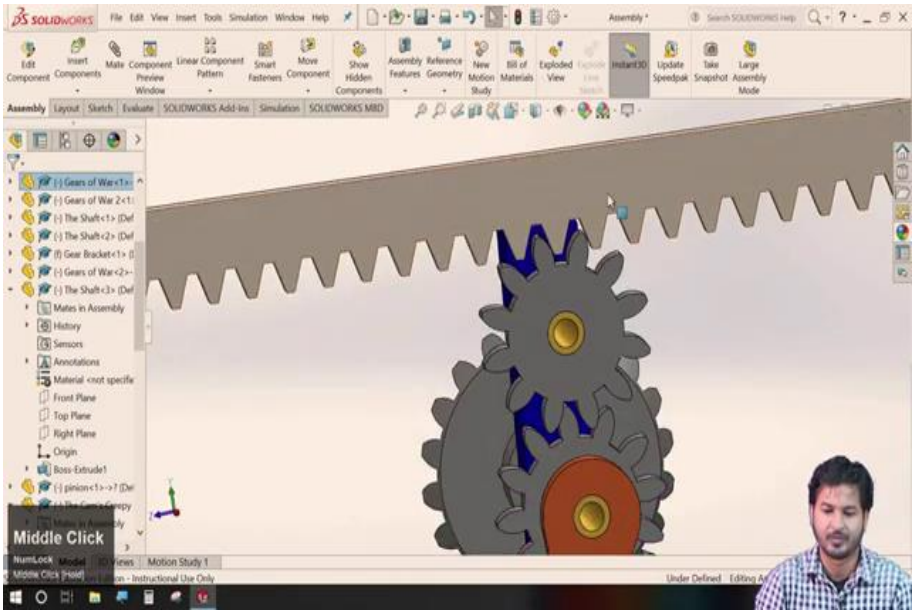
(Refer Slide Time: 26:36)



So, here we have finished this assembly so; however, the mechanical motion part of these is not yet fixed. You can see each of the parts nicely moving, but they are not connected, we have still got to fix this.

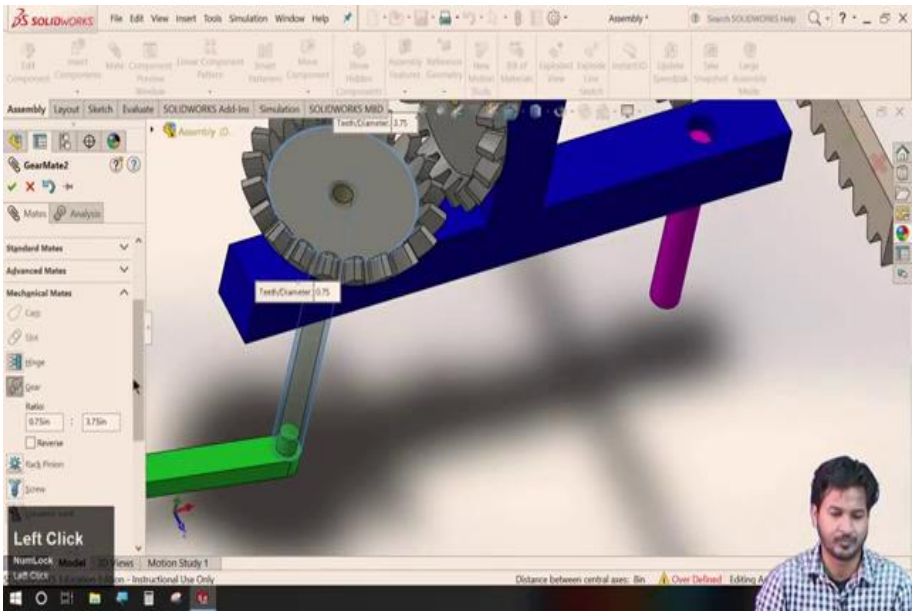
So, for this as in gear assembly, we have to go to align them well I will fix this in this direction see this. So, now, I will lock this position I will make select this face to mate as we did in this gear assembly and we will make an offset click ok. So, now it is fixed to this, similarly, in this, we need this in rack also.

(Refer Slide Time: 31:52)



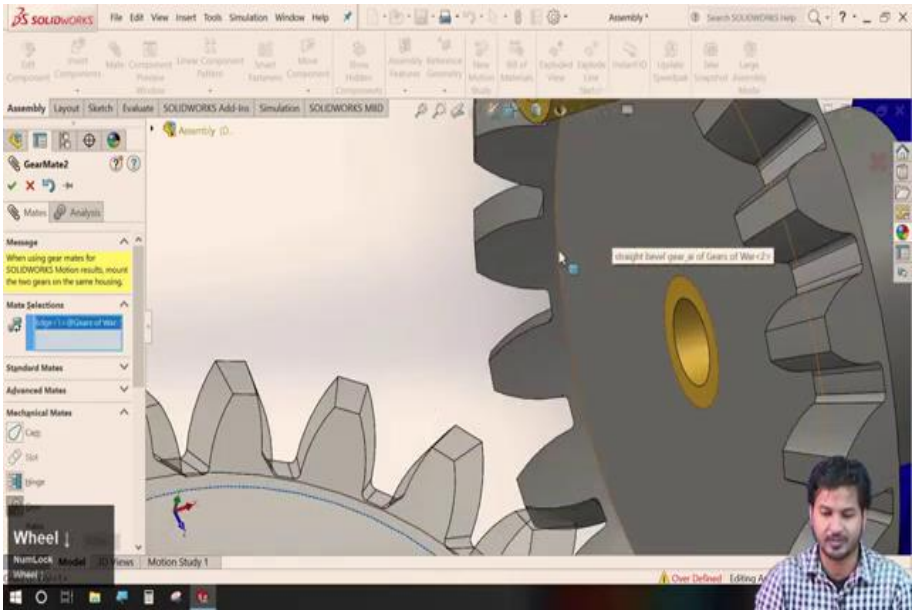
So, let us just fix the position of rack and for this height, I will select this edge and say this particular edge to coincide with an offset. I will select coincide an offset. So, now, we will align these mechanical mates so, we will go to mate then the mechanical mates I will go to gear first I will set up a relation between these two.

(Refer Slide Time: 32:40)



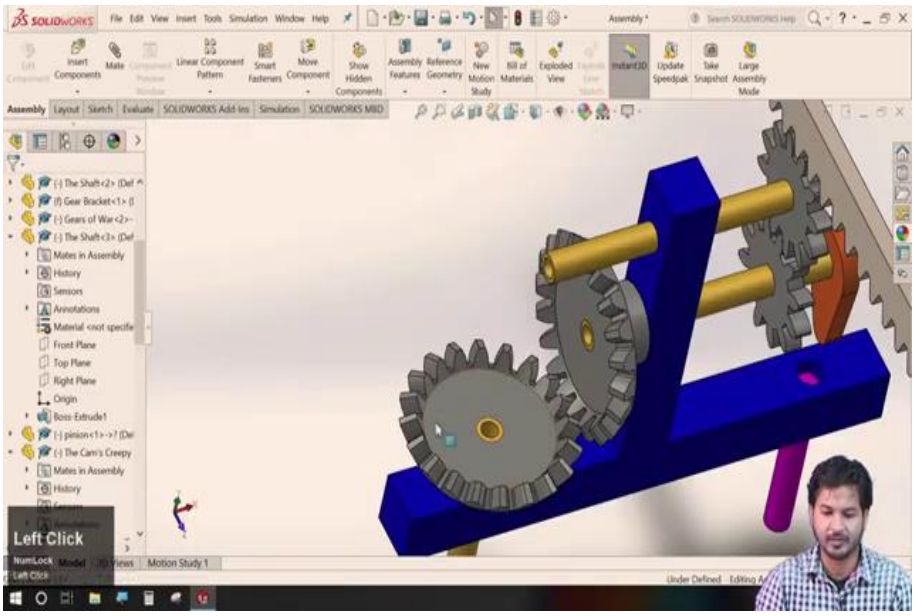
So, for first this shaft has to translate the motion to this particular bevel gear, I will select the edge of this inner shaft and the edge of this outer shaft click ok. So, now on rotating this shaft you can see the gear rotating. Now, we will make a relation between these two mates again gear mate.

(Refer Slide Time: 33:32)



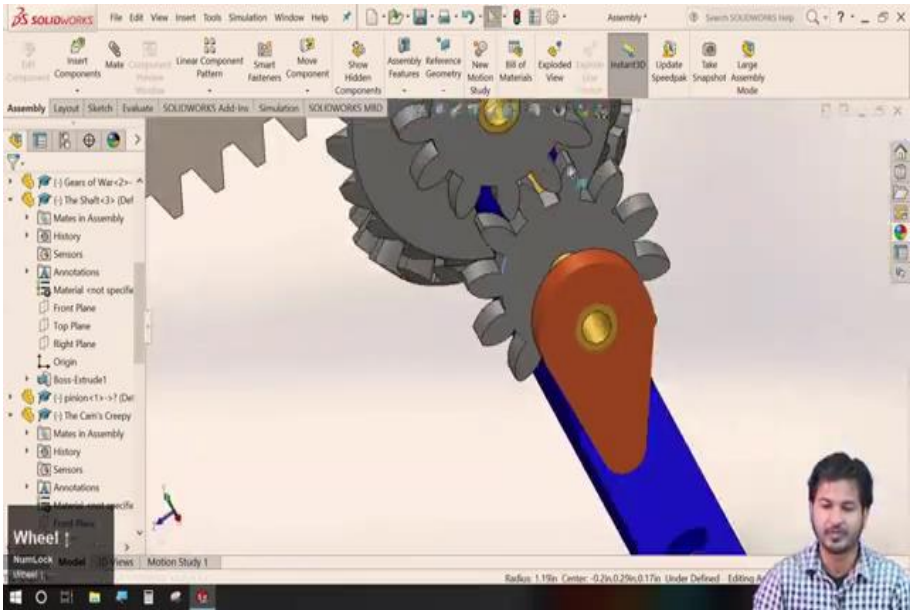
So, let say this and the gear diameter distance just select this edge. I will just zoom it up, say this edge and the edge for this other bevel layer. Now, it will automatically detect the ratio between these two and it is aligned.

(Refer Slide Time: 33:43)



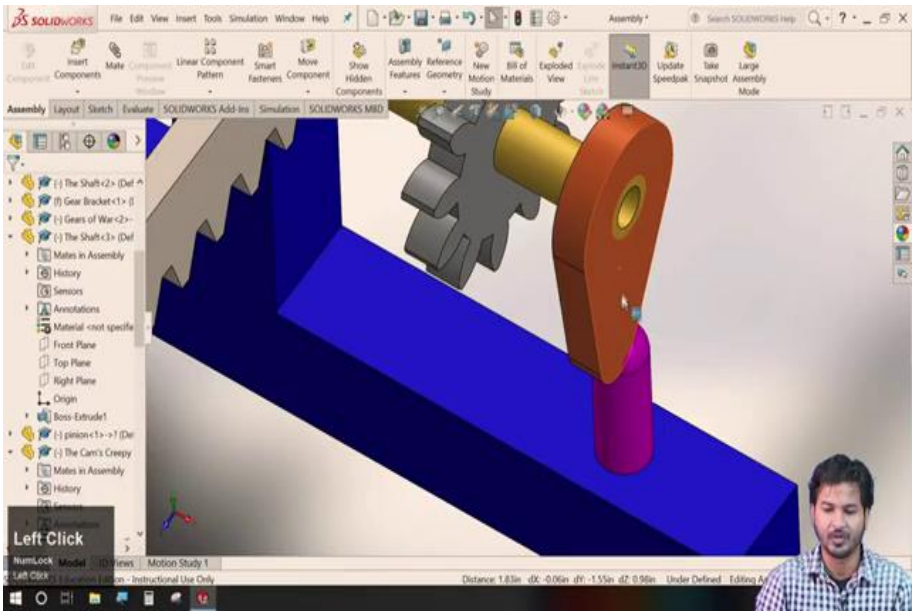
Now, you can see as this lower bevel guide is rotating, it is aligned with the other one. So, now, in the same way, I have got to align this to this gear with this shaft that is housing that mate again we will go to this gear ok.

(Refer Slide Time: 34:03)



Now and this shaft has to be translated, go-to gear, this select this shaft and the edge of this other. So, we can see this as rotating and this is also rotating with this along the shaft. So, now again we have to transmit this power to the upper gear. Now, in the same way, I will go select this particular edge for this gear mate.

(Refer Slide Time: 35:24)

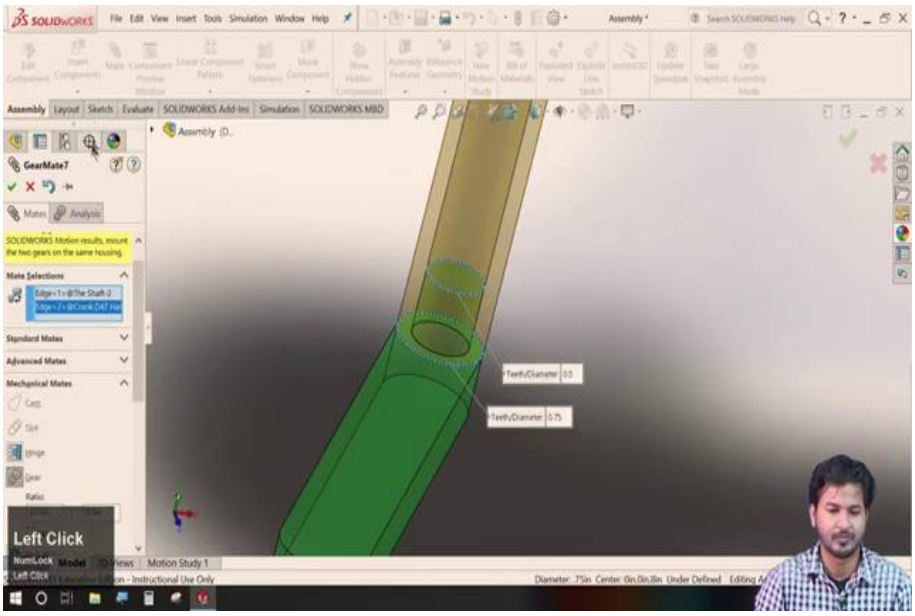


Click this edge and say this edge, it will we can see its diameter ratio the diameter ratio is the same for both of these. So, as we move this is rotating; however, the rack is still to be fixed. So, for this rack, I will go to mate and we will go to mechanical mates, and this rack and pinion as you know this asks for this rack edge length and this pinion will select for now we will select this approximately.

And now you can see this moving. So, we can see as this shaft is rotating all of these parts are moving; however, the cam is still need to be fixed. So, we will quickly go to this cam mate, we will select this cam path and cam follower for this cam follower we need to select the vertex of this.

So, we will select this and click ok. So, now, this is also in rotating; however, this is not yet linked with this gear. So, we again need a gear mate select this cam diameter to this shaft.

(Refer Slide Time: 37:07)



Now, it is well-linked with the other gears. So, now you can see this shaft transmits power to all of the transmits the power to all of these particular parts using these mechanical mates.

However, this handle is not yet fixed. So, because we have not transmitted power from this to this shaft, we can also do this. So, once again we will go to this gear mate, mechanical, mechanical mates, then gear mate I will select we will have to make this transparent to see the inner part I will select click ok. Now, it is aligned with the gear.

So, that you can see as you rotate this handle and we can see all of the parts moving using all using the demonstrated mechanical mates available in this solid works. So, we have similar we have nicely demonstrated these mechanical mates.

So, with this, we this with this tutorial comes to the end of the session and so, with this we have come to an end of this session and we will wrap this up here only and.

Thank you very much and have a good day.