Modeling & Simulation of Discrete Event Systems
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Lecture – 32
Issues in Material Handling System

Welcome to the lecture on issues in material handling system. So, we have seen that the material handling is a very important aspect in manufacturing system and we have also discussed that 80 to 85 percent of time is normally consumed by the material handling process in some production line in any production line. So, it basically forms a very essential component as far as its importance is concerned like you can say the example of automotive paint shops.

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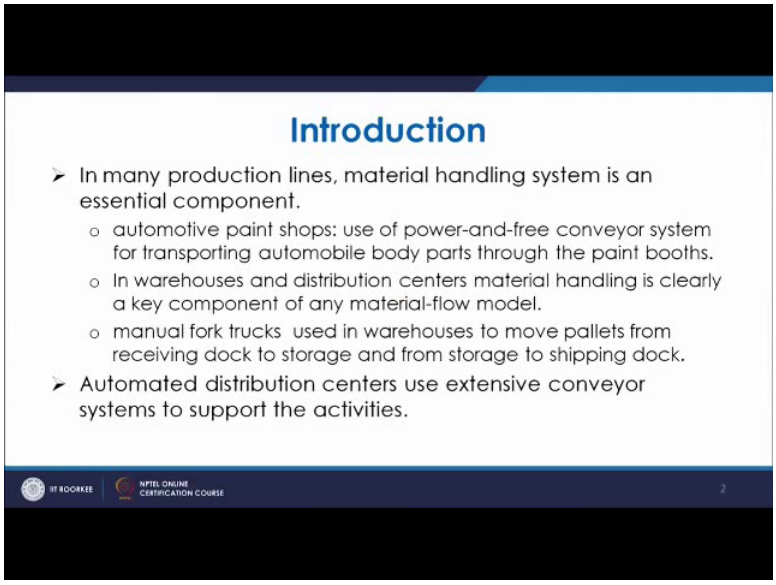

So, in the automobile industry, if you look at you have the points from where the body has to go the chesses has to go the frame has to go. So, you will have the points. So, mainly you will have to have proper material handling system because they have to carry the parts and they have to go at the different point booths in time because they are all automated. So, they have to go from one point booth to another point booth. So, you have different parts different booths and you have to go and certainly that is to be seen that it goes on smoothly.

So, because the ultimate delivery will be depending upon that if any where the process is delayed it will delay the whole process. So, just like in the warehouses at distribution centres. So, they are basically material handling is mainly the key element you have to transport the material from one place to other. So, basically you are the material flow model from where the material is coming and how it has to move, how it has to be transported. So, mainly that is seen where to store it where you know how in less time you have to take the material out at those places. So, all this material flow are going to be very important in those cases.

Similarly, manual flock trucks. So, they are also used in warehouses. So, that is they are used normally in manual warehouses. So, that is basically used for removing the pallets for receiving I mean from the doc to storage and from storage to the shipping doc. So, this way you have the different material handling equipments and they are used for handling this materials and they take some time how much time they take; what is the distribution of that time because it is not that only what is the time taken there are many issues in that because you cannot say with certainty that in that time any material will be transported from one place to other. So, because there is randomness attached to it the machines are there which have the randomness they can fail then they need the time to repair.

So, basically the because most of the things are depending upon the material flow. So, now, for material flow these equipments are required. So, that is why material handling becomes very very important in all these kind of studies now just like automated distribution centres. So, they also use extensive conveyor systems to support the activities. So, this is also again an example of how this material handling is important.

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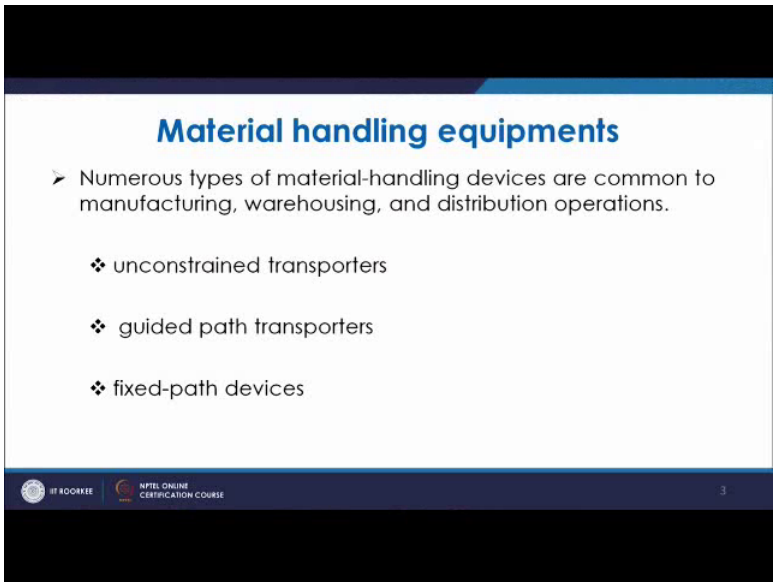

Now, what are the normally material handling equipments which are used in the manufacturing industries? So, you have the common equipments which are used in this manufacturing or warehousing or distribution operations are basically categorised in you know normally they are categorised as accumulating as well as non accumulating then that basically comes under this unconstrained transporters. So, we have the first one is unconstrained transporters.

So, as the name indicates I mean you do not have any constraint to its movement it can move from any place to any place there is no fixed path for its movement. So, that is under the category of unconstrained transporters. So, normally you have to take many things in the plant or in an industry from one place to other and the those things which are required I mean which do not require in a specific path and which can take any you know path to move from one place to other they are come I mean taken care of by the unconstrained transporters.

Similarly, you have the guided path transporters. So, guided path transporters means there is a guided path there is a path which is already made and their you know the equipment has to take the route along that because there may be many times you have the safety shoes also attached. So, you will have to have guided path for them may be there are intricate components. So, there are many issues which are to be taken and then

you have fixed path devices. So, we will see; what are the different kinds of devices in that.

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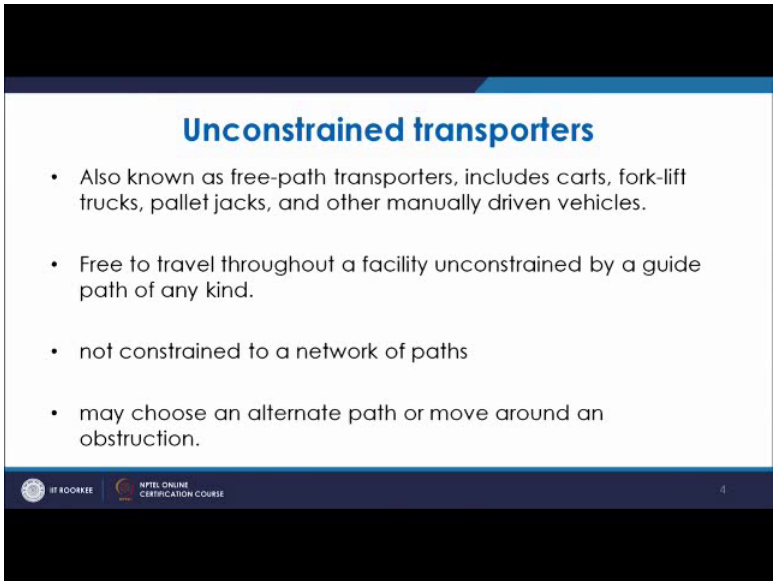

Coming to the unconstrained transporters; so, the unconstrained transporters they are also known as free path transporters. So, they are I mean they include cards forklift trucks pallet jacks and other manual driven vehicles. So, these are known as unconstrained transporters because they do not experience any constraint and they can move whenever required whenever they feel they can go. So, they are free to travel through throughout the facility I mean that is unconstrained by a guide path or any kind. So, there is no constraint guide path there is no separate path or there is no any guided path. So, then this unconstrained transporter; so, here they are free to travel through a facility that is unconstrained by a guide path of any kind.

So, there is no separate guide for the movement of these transporters in the domain, then they are not constrained by to a network of path. So, they can take any route in between they can move from one place to other and they can also take on the way any alternate path or move around an obstructions if they get any obstruction. So, they can surpass them by taking any alternate path. So, they can move around that abstraction and then can reach to their destination. So, the trucks are there or manual levers are there these are basically the unconstrained transporters.

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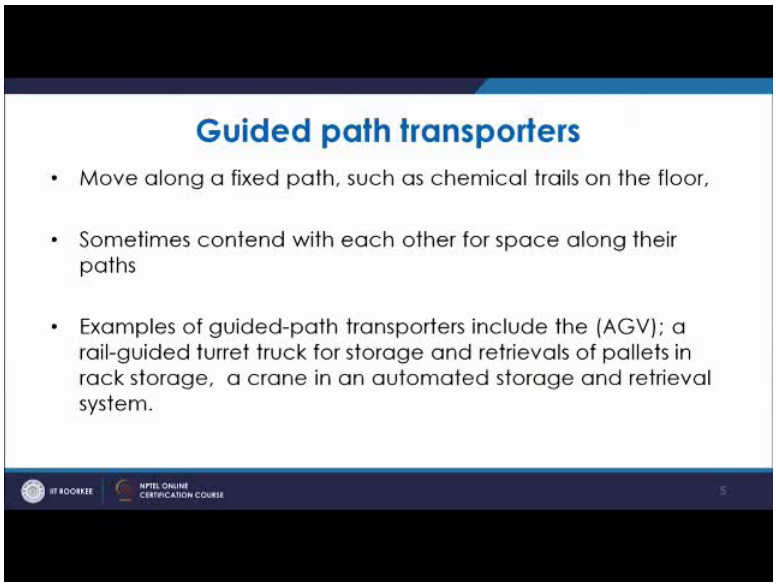

Then you have the guided path transporters. So, this guided path transporters are basically moving along a fixed path like you have the chemical trails on the floor. So, they have to go around a fixed path there are fixed path created for them because if they interact with the surroundings or if somebody comes in its touch then there may be damage to the persons or in other sense I mean even their movement will be hampered. So, even if it is not dangerous also. So, sometimes they had to content with each other for a space along their paths what happens that they have to fight among themselves like they have the same path and if they have to suppose move then if one comes and other also comes in other direction then in that case they are basically contending with each other they one has to wait another has to go like that.

Example of guided path transporters also includes the automated guided vehicles. So, or a rail guided turret truck for a storage and retrieval of pallets in rack storage or crane in an automated storage and retrieval system. So, these are basically the examples in that case you have the guided path and they have to go and other equipment cannot come its way otherwise it will be hampered. So, they have to move like that and their path is normally fixed. So, means guided.

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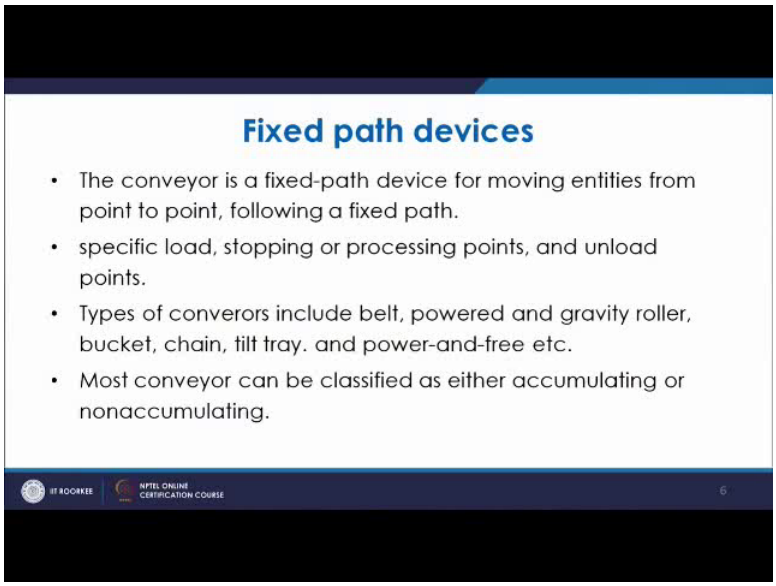

Then you have the fixed path devices. So, fixed path devices means like conveyors which has a fixed path which is fixed on its own the guided in the guided you know path you have the network. So, there may be many networks and the transporter may go to this network or this network that can be designed in that case basically the operator who is controlling he has to control that this time the chemical has to move through which channel or the truck or the crane has to take which route or so; so that another crane which is also going it should not be put on the same route now in the case of. So, that is there in the case of guided path now in the case of fixed path; the example is typical example is conveyer. So, normally they are fixed they are fixed to its position. So, they are fixed path devices and they are used for moving entities from point to point following a fixed path.

So, as we see there are many types of conveyors and normally the conveyors are fixed to the 2 points you have the belt conveyors or you have different kind of conveyors you have the roller conveyors bucket conveyors or. So, so they have a fixed path they have to move there itself you have to nothing can come in their way, I mean no other transporter can come in their way they. So, you have to do what you have to do is the product which is to be transported it has to be put in its location I mean wherever this fixed path devices is I mean located and then that will move on its own path fixed path and then it will go to different you know processing points now all these kind of devices they have certain specifications basically they are depending upon the type of these fixed path devices

either they carry the product which is in powdered form they may carry something which is in lump form they may carry something which is very delicate they may carry something which is very you know not delicate at all.

So, depending upon that you have different kinds of this; this type of devices and what is the specific load like how much it have; it will be the weight which will be carried. So, then basically the different points are there; there may be they may go in a horizontal direction it may go in a vertical direction. So, how to unload what are the unload points. So, all these things are important I mean to decide which kind of you know fixed path devices like conveyers are to be used. So, you have different types of conveyors like belt conveyor powered and gravity roller conveyor bucket conveyor chain conveyor till tray power and free all that I mean free conveyor. So, all these type of conveyors are available.

Now, most of these conveyors; so, they are basically classified either in terms of accumulating or non accumulating. So, we will discuss that what is. So, accumulating as we mean the accumulating means once the any product which is at the ahead if it stops then there will be sleepers occurring and it will be having at its point and the conveyor will move. So, that the item which is there on the back. So, that will come and then they will collide or they will accumulate and otherwise you have non-accumulating. So, as we discussed that normally we are classifying them either as accumulating or non-accumulating.

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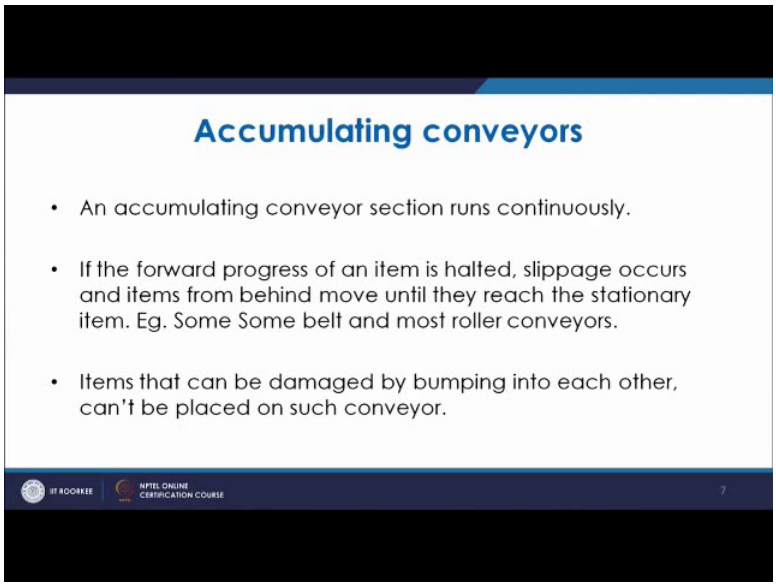

Now, in the case of accumulating conveyors it is said that they run continuously. So, the conveyor section will run continuously and if the forward progress of an item is halted then there will be sleepers occurring. So, what will happen? The item from behind; it will move until they reach the stationary item. So, there are 2 items and that will be stopped.

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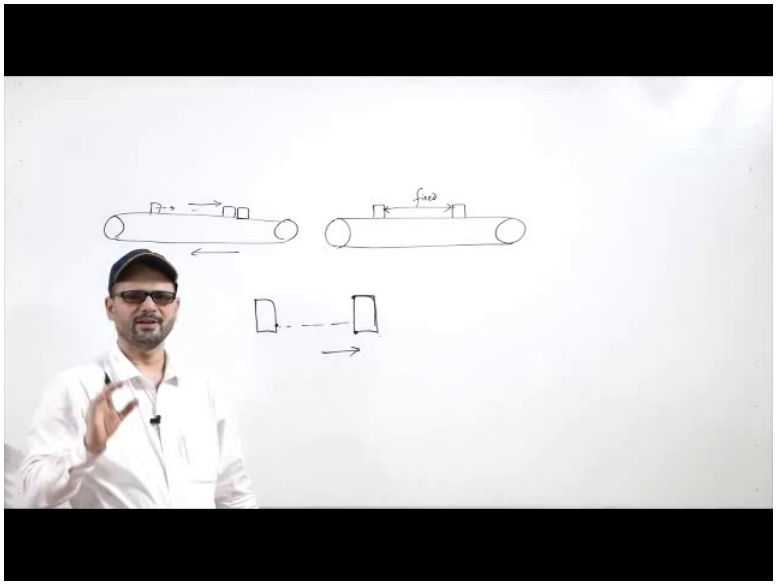

So, if one gets stopped. So, you have suppose you have the conveyor and so, it is moving in this direction and you have the items here and you have the items here. So, it will be moving. So, in the case of if you stop here then this will basically be stationary at its

point while this is basically moving. So, there is slippage between this product item and the belt.

So, this product will come and ultimately it has to come and take this place. So, this will move and this will be stationary. So, in such you know conveyors you have to be cautious that when they are basically attaching to each other they are accumulating. So, you have to be cautious that what kind of items you are trying to transport over that. So, basically, if they are getting damaged if they are items which may get damaged because of their interaction because they are coming and closing to each other in that case we are trying to avoid putting such items on that; so, normally raw items or the products which are basically used raw materials.

So, that can be used on thus on this type of conveyors. So, that you have not to worry because anyway they are going to be processed. So, possessed goods finished goods they should not be put on that because once they are on that. So, before suppose you are making casting. So, the casting even before going into the you know shop where they have to be further fettling is to be done or cleaning is to be done you can put them on that and that to you have no delicate parts which can collide and they can break by colliding. So, such parts are not suggested to go on such conveyors. So, basically they come and they get accumulated and then they are they are you take can take it out or you can use it for some other purpose.

Then you have non accumulating conveyors. So, this is contrary to the accumulation conveyors.

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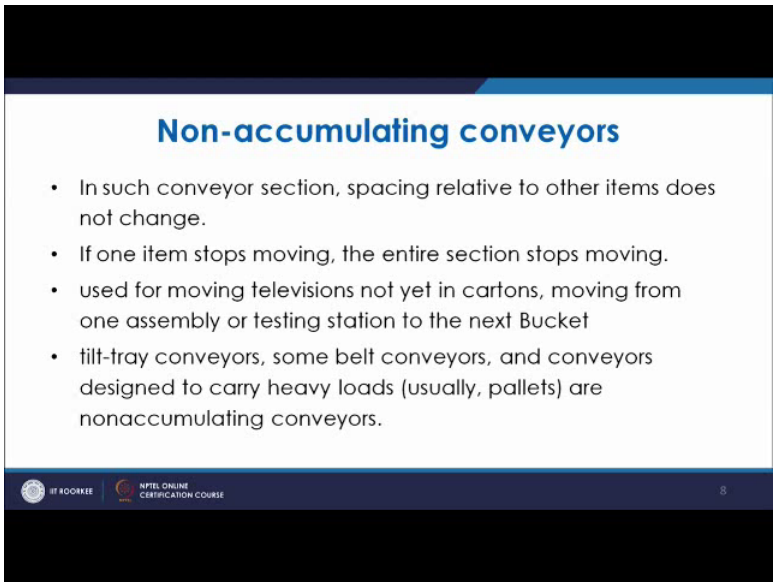

So, in accumulating conveyors, you have the item which is there in the front. So, if that is stopped the item from behind; the product from behind will come and then they will get accumulated where as in non accumulating type of conveyors. So, this is fixed. So, if you have the conveyor. So, that basically is fixed. So, you have a fixed this will be always be fixed. So, this distance will always be fixed. So, if one stops it has to stop. So, in such conveyors the spacing relative to other items does not change. So, if you have keeping the 2 items at 2 places they will always be the same. So, they cannot change, the relative spacing between the 2 items cannot change.

So, it means that if one of the items stops here then the conveyor will stop the entire section stops moving. So, basically these are used for such commodities which are precious which on which we have to be careful that this would not collide I mean you have to be maintaining a clear gap between the products so that you can see that they are quite safe. So, use for moving televisions not yet in cartoons you have made the television by assembling the different parts together as long as you have not assembled it you can put on the accumulating type of conveyors you can have bolts together you can have panels together you can have everything may be in that different type of conveyors and they can be accumulating, but once you have assembled them totally and now they are finished.

Now, you have to protect it for any further damage. So, that can be ensured by keeping them at the fixed places. So, that if due to any reason the item at the head is stopped then in that case the whole section stops. So, that that distance is maintained and there is no threat to the item which is there the precious item which is there on that or I mean there may be any kind of problem there maybe noise there may be you know breakage of the items. So, that way moving from either. So, you have many assembly points; so, from one assembly to other assembly point or testing station to the next bucket like that. So, there may be many you know places where the item has to move. So, once it stops everything will stop.

Examples are like till tray conveyors some of the belt conveyors or conveyors design to carry heavy loads. So, normally these are the non accumulating type of conveyors because once you are carrying the heavy loads then you see that they maintain a distance because that may be threat for the persons nearby there maybe threat for even because they may collide and they may get damaged. So, there are many kind of challenges in those cases. So, in those cases we use these non accumulating types of conveyors.

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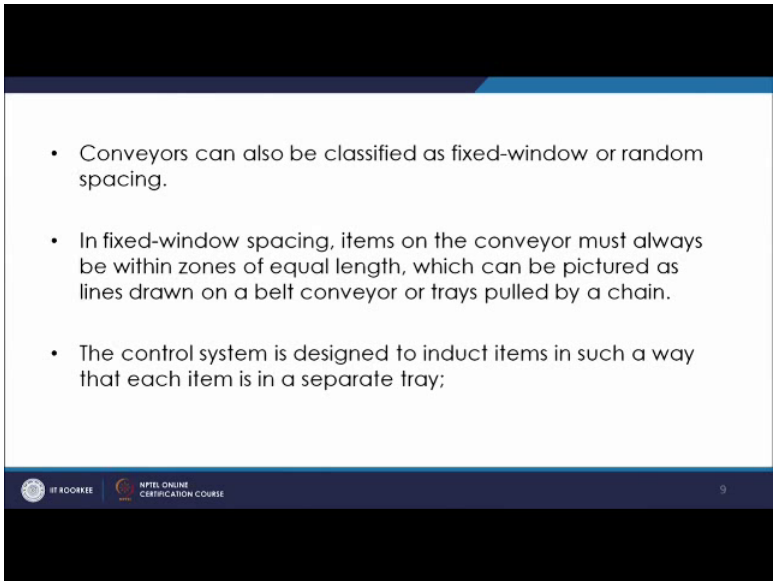

Conveyors can also be classified as fixed window or random spacing. So, either it is fixed window or it is random spacing. So, what happens in the fixed window spacing that items on the conveyor must always be within zones of equal length? So, that is known as fixed window type of spacing for the conveyors. So, which can be so, you have the lines

drawn and it should not cross that line. So, the items will be kept on the conveyor and then the lines are drawn that in between the item has to be in within that line itself there should not be any you know any type of crossing the lines or so; so as on the belt conveyor, you may have the lines drawn with different lines different colours or. So, or the trace pulled by a chain. So, these are the examples of that. So, you have the control system which is designed to induct the items in such a way that each item is in the separate tray. So, you see that the control system is in such a way that you are keeping every item in the separate trays.

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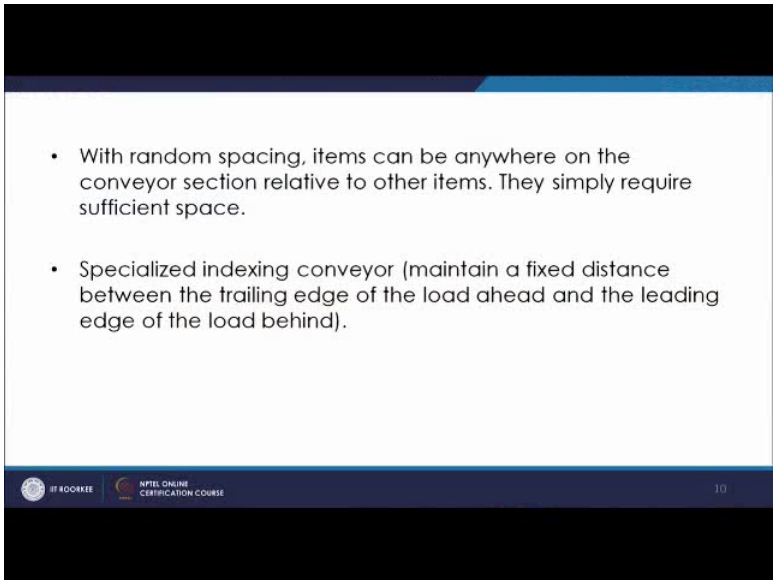

Now, then you have on the contrary you have the random spacing now in the random spacing items can be anywhere on the conveyor section. So, you do not have you know any fixed position where the items should be there. So, in that case you have you can put anywhere. So, the requirement is that this you should have the ample of the space. So, this space requirement is important in such cases you have also a specialised type of indexing conveyor. So, basically in that what happens you have a; to maintain a fixed distance between the product which is at the front its back point and the product which is behind its front point.

So, suppose you have 2 points. So, this; if this is moving like this. So, this is a front. So, in front you know its back though the product which is moving ahead its back position and the product which is behind its front position now in this you have very specialised

you know indexing is done. So, you have a fixed distance you have to maintain. So, this way you maintain. So, these types of specialised indexing conveyors are also available.

Now, we will discuss about the modelling of system randomness. So, when we are discussing about the manufacturing system in that basically there are common sources of randomness as you know that since in the manufacturing system you have good amount of activities going on and there are many things were the randomness is there, you cannot remove that like the examples are like inter arrival times of orders or parts.

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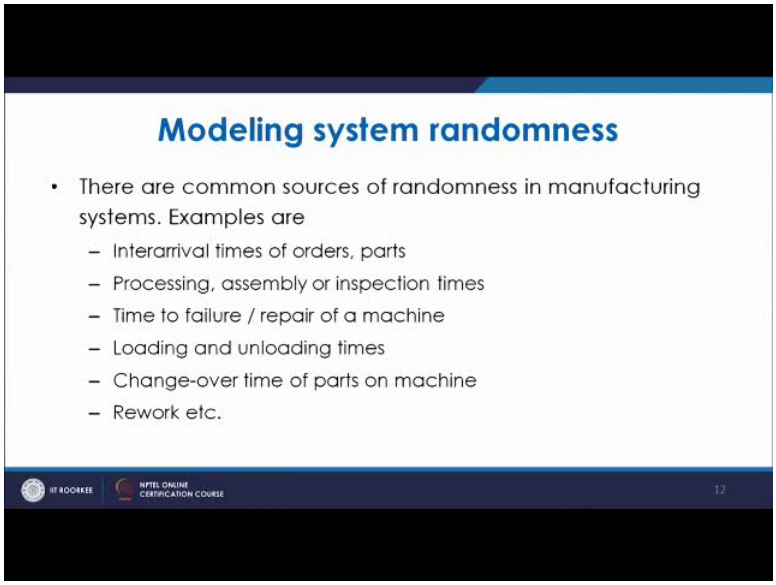

How much time it takes for the orders to be placed or parts to come then you have processing assembly or inspection times. So, these are also I mean probabilistic you know you have values you do not know what is the deterministic time for this processing or for the assembly or inspection.

So, you have to see into it that how it will vary. So, you must have the knowledge about this randomness associated with these units like you have the time to failure or repair of a machine. So, many a times when you have machining centres work centres then you have machines and the product is coming; the raw material is coming or stock is coming that is going to be you know possessed on that. So, the thing is that it is natural that machine has to fail now what will be the time to that when the machine will fail. So, that is very random you do not know, but then that can be you know guessed by looking at

the past history by looking at the density function probability density function and you can say that yes there is probability that in the coming 2 days there may be some failure.

Similarly, once there is failure then you have to repair the machine now for repairing the machine how many of how much of time is required and for that time you will have the downtime because at that time there cannot be any work on the machine. So, you have to repair it may be that you do not have immediate availability of the repair person you have to wait or other repairs are going on. So, it has to further wait. So, there will be waiting time for even for the machine or for the work. So, that it goes under the machine to be repaired. So, these are the basically system randomness.

Similarly, loading and unloading times when we talk about the dock yards or in the warehouses. So, we have to load and unload and normally if it is automated it is, but in most of the cases it is also probabilistic because when if it is automated there may be certain kind sometime there may be down time there may be failure or there is going some repair to the machine. So, there is always some randomness associated with loading and unloading times. Similarly when you are using the parts on the machine and you have to change over the tool. So, or you have to change over the parts on the machine.

So, that is also taking a time and that is random because you do not have the deterministic time you not know how much time it will take. So, these are the system randomness which are their rework is their rework may come out of hundred units there will be some units which may come for rework. So, there is certain probability associated with that and that you can get from the basically past data.

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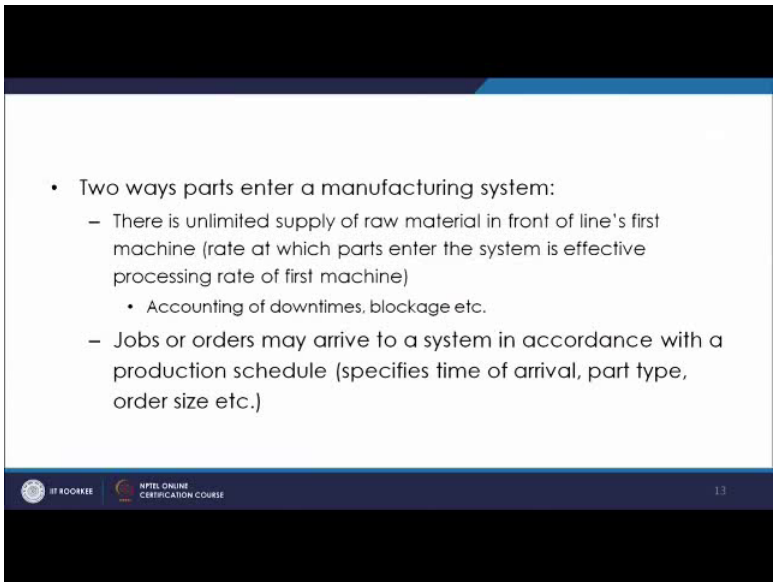

So, basically there are 2 ways the parts enter into a manufacturing system. So, you have one way is that the parts are always available and the machine is standing and parts are available in ample. So, in that case the rate at which parts will enter the system it will basically depend upon the processing rate of the machine which is there. So, that way it will be decided by that and so, in that you have to see whenever the machine fails in that way that will be you know that is to be taken into account.

And another is that jobs or orders may arrive to a system in accordance with production schedule. So, you have the specific times for arrival part type or order size. So, in the 2 ways you have the you know materials coming to the system and you have to know as we discussed in the first way that you have to keep in account the down times because if you are waiting for the machine to get repaired. So, that is basically a down time you have you do not have any work which is going on. So, that is to be taken and that is basically you know random you do not know when it will come; how much will be the down time. So, this modelling is required these are the issues while dealing with the material handling system. So, this is how this I mean this way you can see that how to model these down times.

Thank you very much.