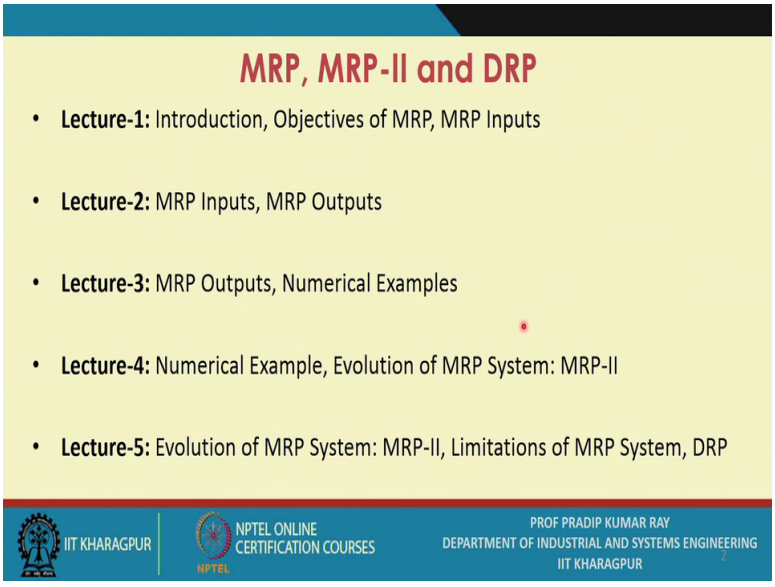
Management of Inventory Systems
Prof. Pradip Kumar Ray
Department of Industrial and Systems Engineering
Indian Institute of Technology, Kharagpur

Lecture - 31
MRP, MRP-II and DRP

During this week we would like to discuss a very important topic called a material requirements planning or MRP. Now, this particular the system of a production and inventory control is made available in different forms and as it is a computerized system obviously, you know this MRP system or material requirements planning system has evolved through several types of or several versions. So, during this week we would like to discuss material requirements planning in different forms.

So, the first one is its in original form it was introduced in mid 70s and this is referred to as MRP, and subsequently we later on a new version of MRP or extended version of MRP was introduced that is referred to as the MRP-II or manufacturing resource planning. And then later on even for the distribution network the concept of MRP we can be applied. So, we move to distribution requirement planning. So, during this week all these the 3 aspects we are going to discuss and as the topic is management of inventory systems you will come to know it is already known.

(Refer Slide Time: 02:01)



We have mentioned this is very important point that that inventory control system is very much linked to the production control system. And when you talk about say the material requirements planning, or manufacturing resource planning or the distribution requirement planning. So, mainly we concentrate on two aspects, one is the inventory control and the second one is the production control.

So, so while we establish why we implement such a system obviously, the system concept is applicable, and what we propose that is an integrated system for inventory and the production control. And all these 3 kinds of systems have been well adopted by several organizations around the, so the different countries of the world. Now, there will be 5 lecture sessions.

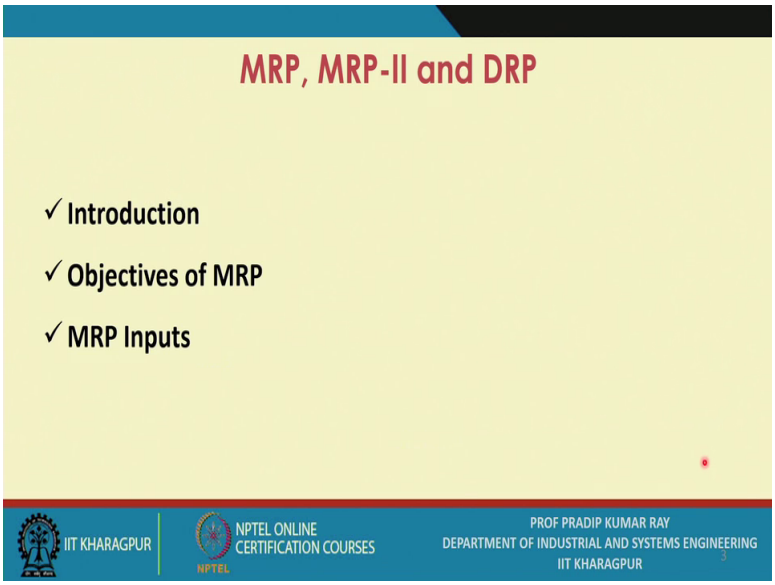
So, let me first tell you what are the topics we will be the covering we intend to cover the lecture wise. During lecture 1, we will introduce the concept of material requirements planning and under what condition you are supposed to use this particular system, we serve is the traditional system. Specifically we will mention the objectives of MRP and while you create and MRP system that means, you should be aware of what kinds of inputs you must have in this particular system. So, we will start discussing on MRP inputs. You must have very clear idea about the MRP inputs.

During lecture 2, second session we will continue our discussion on the MRP inputs, a detailed discussion is required and then we will also referred to the MRP outputs. So, for the system the inputs and then outputs both are known. And then during a the 3rd lecture session we will discuss MRP outputs there are many other aspects. So, different aspects of all the characteristic features of these outputs we will refer to and then we will take up a few numerical examples.

During the 4th lecture session, we will refer to another numerical example. So, that your understanding is appropriate and then we will talk about how these MRP system has eve evolved through the through the diff through the years and particularly we will refer to MRP-II or manufacturing resource planning what are the characteristic features of MR 2 system.

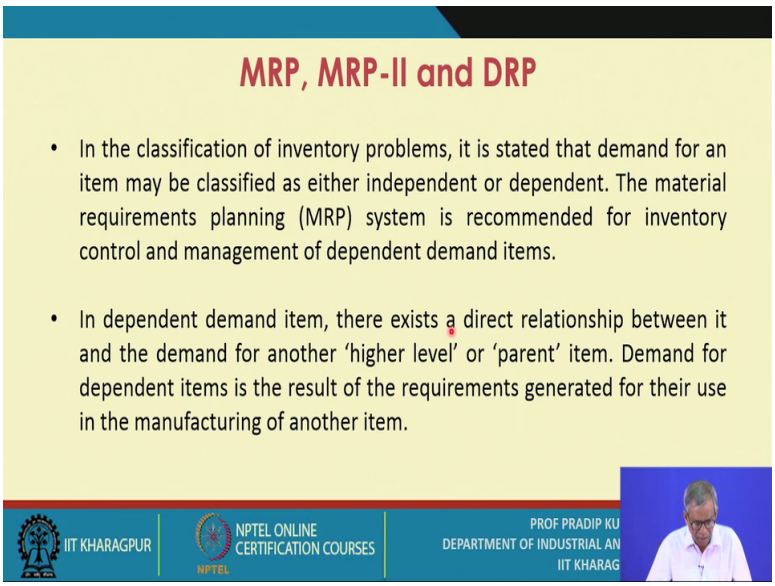
During the last session we will talk about the evolution of the MRP systems that means, we will continue our discussions on MRP-II, the limitations of MRP systems specifically you should mention and we will mention it. And then we will we will briefly discuss the characteristic features of the DRP distribution requirement planning with its working as well as with its limitation, ok. So, this will be your brought will be your brought coverage.

(Refer Slide Time: 06:08)



Now, let us the talk about the characteristic features of MRP system, objectives of MRP and MRP inputs, ok.

(Refer Slide Time: 06:21)



Now, we have already discussed till the 6th week of our the lecture sessions. We have referred to different kind of inventory problems and we have classified the inventory problems and there are we need to say consider several say the factors in defining a particular inventory problem. And we what we have proposed we have proposed the formulation of the problem and we also referred to the solution approaches.

Now, if you refer to all these formulation as well as the solution approaches you will find that only for one kind of the item or one kind of say the products or one kind of the components, or inventory item we have formulated the problem. And what is this type of say they inventory item? Now, this type is referred to as independent demand type.

So, you know what is an independent demand type say the item or independent demand items. So, whatever say the mathematical models we have referred to, we have discussed to, we have taken up, these are all you know the applicable for independent demand items. And of course, in a manufacturing systems or in any organizations producing different kinds of outputs or the goods and services or the products and services you are able to identify the what are the independent of the inventory items, ok. Mostly at the end product or the end goods and services.

Now, in order to produce the end product as per the bill of material or as per the product structure code what you need to do you need the raw materials and you need to consider the WIP inventory. So obviously, if you look at a particular manufacturing systems what you find that these raw materials and this you know the WIP inventories these are all used or these are all required in the necessary for producing the end items. So, these you know the inventories are referred to as the dependent inventories. So, now, so the dependent the demand items you are already aware of the dependent the demand items. Now, for dependent say another demand items it is very difficult if not impossible to propose a mathematical model.

So, and even if you propose a mathematical model you will find that these mathematical any mathematical models will be constrained by so many assumptions and this model may not represent a real system. And even if you model it here you may not get the closed form solutions for the relevant parameters of inventory control systems. And as I have already pointed out that inventory control system is closely linked with the production control systems. Now, the modeling this the linking mathematically it is very very difficult if not say impossible, this is point number one.

The second point is you know in order to produce the end items particularly for the repetitive manufacturing you need to deal with the large number of large number of say the intermediate items or the dependent demand items. So, and the in this dependent demand items are needed at different levels of the product structure or the bill of material. Now, and there all the dependent with one another that means, you have one item. Now, these item

demand is dependent on it is that the demand of its parent items and similarly the demand of the present item it is you know it is dependent on the demand of the present item and the next and the next higher level, so this process continuous.

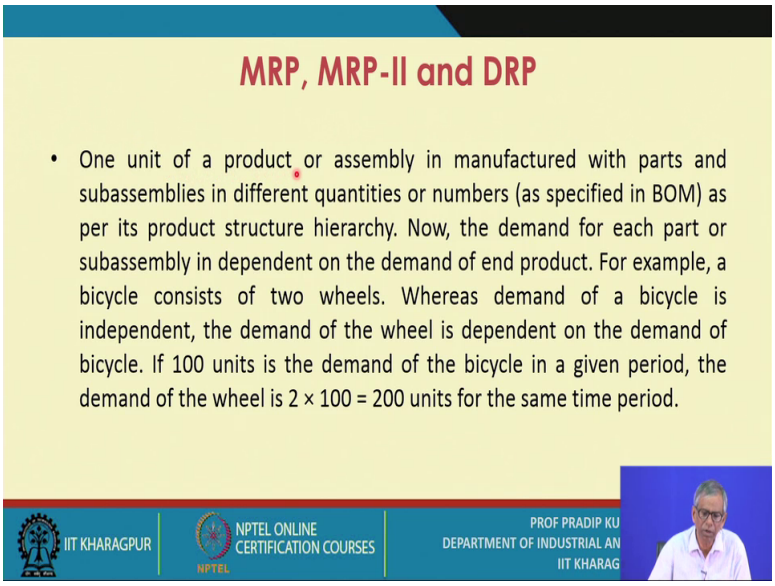
And when you look the bill of material for the end product depending on how many say the items you have, what kinds of the raw materials you required, how many sub assemblies you have, there could be n number of the levels. And this is called basically the product structure hierarchy. And as you have more number of items to be considered or for designing and manufacturing end item or end product so there is all likelihood that you will have large number of such a levels. So, the dependency between the different levels you need to consider and it is very difficult to mathematically you know so the formulate the problem.

So, what is alternative? Alternative is that why do not you propose and online real time say the control systems inventory control systems. And while you propose an online real time inventory control systems for say the dependent as a demand items obviously you know these online systems or the real time systems have will have a closed link with the production control systems, so that is alternative. Many companies forward the last 50 years or so, across the world. So, they have been adopting a say this online the real time system. So, MRP is basically an online real time say control systems inventory and production control system.

Now, let us go through these comments. Like in the classification of the inventory problems it is stated that the demand for an item may be classified as either independent or dependent. This point already I have made clear. The material requirements planning I repeat it is material requirements planning or MRP system is recommend for inventory control and management of dependent demand items, is it ok.

In dependent demand item there exists a direct relationship between it and the demand for another higher level or parent item, as per the structure of the bill of material which is many a time referred to as the product structure code. Demand for dependent items is the result of the requirements generated for their use in the manufacturing of another item. So, with their there are many examples of the dependent the demand items. So, definitely we will refer to a few examples and then the concept you will have a proper understanding of the concept.

(Refer Slide Time: 14:43)



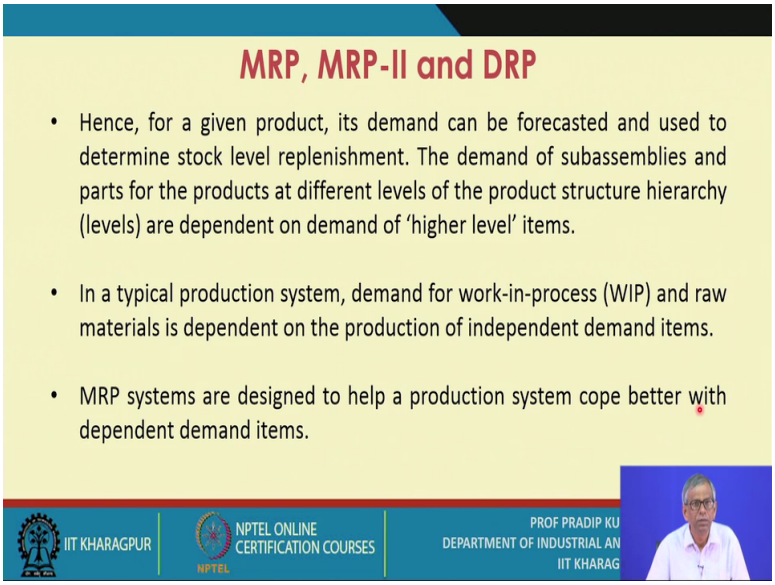
Now, one unit of a product or the assembly that means, the end product in a repetitive manufacturing case may be thought of as an assembly. So, one unit of a product sometimes this is referred as the output in is manufactured with parts and sub assemblies in different quantities or numbers as specified in bill of material as far its product structure hierarchy. That means, what is the bill of material that means, this is the document actually the preferred by the design department.

And if you look at this document what do you find you find? You know these information that means, to produce one unit of output or say the end product, how many different types of raw materials in different quantities or the sub assemblies are you now, the other types of parts you require you required to produce, you required to assemble so all these information you get from the bill of materials. So, this is the out output or the outcome of the design department.

Now, this is one of the document others the documents you always referred to while you create an MRP system. Now, the demand for each part or the sub assembly is dependent on the demand of the end product. For example, a bicycle consists of two wheels this is the very simple example and you will come to know actually what we are proposing or what we are the trying to say explain whereas, demand of a bicycle is independent, because this demand is dependent on the outside factors like the marketing related factors.

The demand of the wheel is dependent on the demand of the bicycle. A simple example is if hundred units is the demand of the bicycle in a given period the demand of the wheel is 2 into 100 that is 200 units for the same time period, ok. So, this way you calculate. So, this is just an example. So, at different levels you have the different units when we refer to the numerical examples this point will be made very very clear.

(Refer Slide Time: 17:36)



Now, what do we are saying, that for a given product its demand can be forecasted that means, you know the end product normally what you have in a good or say progressive manufacturing the company of for that matter the other companies also of other types you will find the forecasting of the demand is an important issue. Though that maybe some error there may be 5 to 10 percent error or say 1 to 5 percent error, but you your starting point should be the forecasted says the demand levels for the given end product.

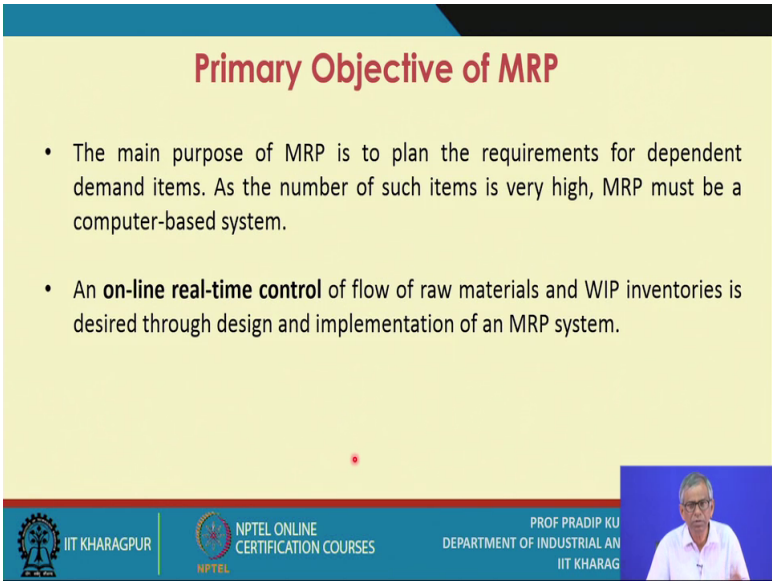
And used and this the demand is used to determine the stock level replenishment. So, if you refer to you know the different kinds of formulations for the inventory problems and you will find that one of the parameter to be determined the value of one of the paradise order quantity. So, it is a Q - systems of inventory control.

So, and one of the important factor determining order quantity is obviously, the demand level. So, demand of sub assemblies and the parts for the product at different levels of the product structure hierarchy as you find in its bill of material product bill of material are dependent on demand of higher level items. In a typical production system demand for work in process or

WIP and raw materials is dependent on the production of independent demand items. This point already we have we have elaborated that means, how much the raw materials we required the depending on say the requirements as specified in the bill of materials, ok. That means, to produce one unit of output how much raw materials of a specific type you require. So, that information is given to you.

And then when you when you know the demand level of say then end product, so you just calculate as for the demand level of the end product what is the total requirement of a specified or a specific so the raw materials to be used. So, this rule is followed. Now, the MRP systems are designed to help a production system cope better with the dependent demand items, ok. So, this is just a further elaboration.

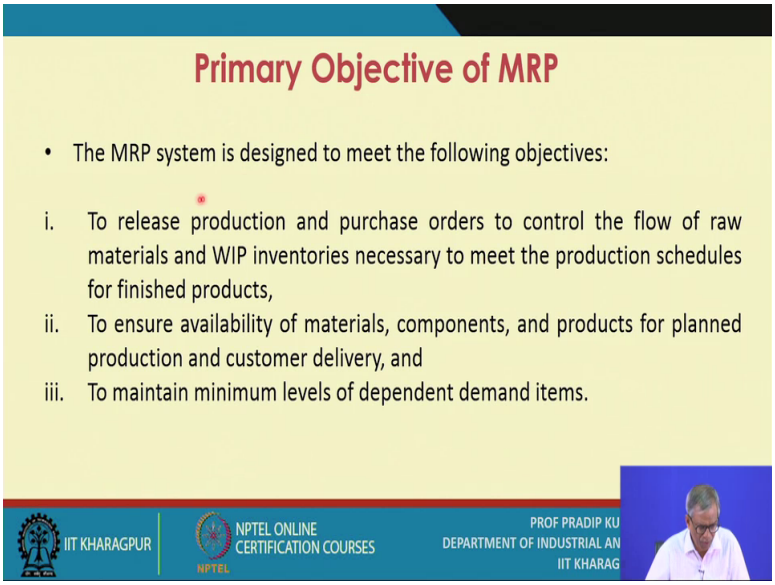
(Refer Slide Time: 20:18)



So, the main purpose of say material requirements planning is to plan the requirements for dependent demand items. As the number of such items is very high this point already I have mentioned MRP must be a computer-based system. That means, even in the 70s you will find that there are there had been several say the applications of MRP systems and the companies which use to have say the computer those days, they felt like the implementing MRP systems. That means, the dependent the number of dependent the demand item is always very very less, but the number of say the independent demand items is always number of dependent demand items is always very very high and so the computer based system is a must.

An on-line real-time control of flow of raw materials and the WIP inventories is desired through design and implementation of an MRP system.

(Refer Slide Time: 21:38)



Now, what are the specific objectives of MRP? And those are referred to as the primary objectives of MRP. You must have very clear idea aboutthese objectives. And if you know its objectives that means, you will also be able to asses in a given situation where at a particular point in time whether the MRP system is implementable or not or it is or is it the you know the basic need at this point in time.

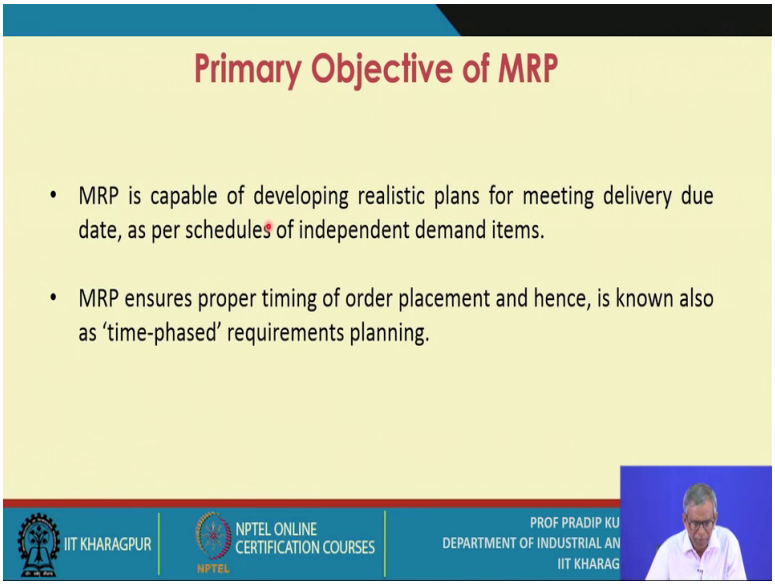
So, the release; so what are the objectives? The first objective is to release production and purchase orders, ok. So, later on when we when we discuss the purchasing management systems so you will come to know that that the purchase order or you know the purchase order is a document which actually you know the triggers for the many types of actions required for procurement of the ordered the items. So, what do you need to do? That means, at a periodic interval or at infrequent say the time intervals you need to release the production and purchase orders to control the flow of raw materials and W by WIP inventories.

Now, as we have been emphasizing all the time that that ultimate objective of any inventory and production the control system is to is to get a smooth flow of materials within the manufacturing systems. And you can extend this smooth flow of materials say the beyond manufacturing systems like say you know the distribution system also. So, many time the manufacturing systems or the factory systems and the distribution systems you may you may

consider as as one system and so that is why ultimately so the MRP system must be extended to the distribution requirement planning systems.

So, our concern is controlling the flow of raw materials and WIP inventories necessary to meet the production schedules for finished products or the end items. To ensure availability of materials components and products or plan production and customer delivery customer delivery at the right time, and to maintain minimum levels of dependent demand items. So, this is very very important as per as inventory investment is concerned.

(Refer Slide Time: 24:35)

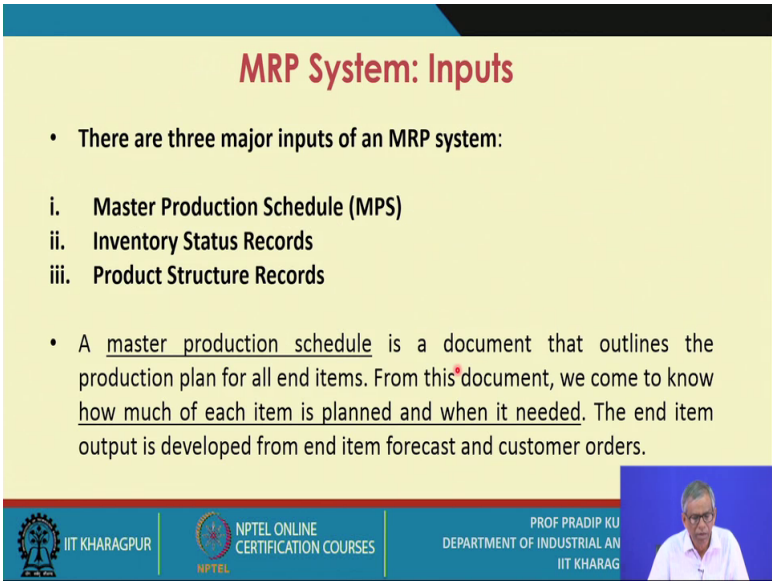


Now, MRP is capable of developing realistic plans for meeting delivery due date. Later on when we take of for numerical examples so you will we will elaborate this concept that means, here the one objective is that how to made the delivery due date, ok. There maybe other say the objectives in a typical say the operation scheduling problems, but as per as MRP is concerned that means, just one objective you have to meet, that is the delivery due date say this you have to meet this delivery and due date condition, as per the schedules of independent demand items, ok.

So, MRP ensure proper timing of order placement and hence is known also as time phased requirements planning that means, as a planning horizon you need to determine say a few weeks or say 10 weeks or 15 weeks. Now, week wise you need to the specify your requirements and the week wise also you need to the specify your order quantities, your you

know the manufactured quantities and constantly you have to monitor the situation or monitor values, ok.

(Refer Slide Time: 26:16)



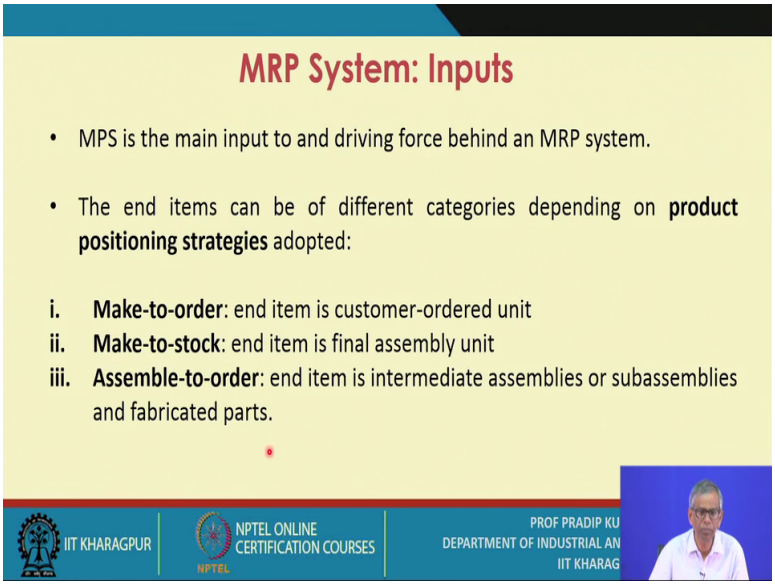
So, that is why it is refer to as the online real time systems. Now, there are 3 major inputs. Now, we are referring to MRP system input. So, this is your starting point suppose you want to create an MRP system. So, the first thing you look into that ist he inputs. So, what is the input essentially it is an input output based systems, ok. So, there are 3 major inputs of an MRP systems, the first one is a master production schedule or the MPS.

So, this is the primary document this is the starting point. That means, the master production schedule you must be able to create and usually your basic inputs is aggregate production plan. So, once the aggregate production plan is made then you will be able to so the prepare this particular document that is referred as the master production schedule, MPS. Then the next one the next important so the input document you refer to that is referred to as the inventory status records. That means, as of now what is the status of inventory of a given item. And then the third one is the product structure records or this is basically the bill of material for the end items.

Now, a master production schedule is a document that outlines the production plan for all end items that means, the end product or the assembly. From these document we come to know how much of each item is planned and when it is required that means, quantity and timing, ok. So, the information pertaining to the quantity and the timing is made available from this

document. The end item output is developed from end item forecast and customer orders, this point already I have mentioned.

(Refer Slide Time: 28:20)



Now, mps or master production schedule is the made input to and the driving force behind an MRP system. The end items can be of different categories depending on the product positioning strategies adopted. So, what are the product positioning strategies? I have already mentioned in the in my initial lecture sessions, like say what extend the inventory management system is related to the product positioning strategies. So, please refer to those lecture sessions.

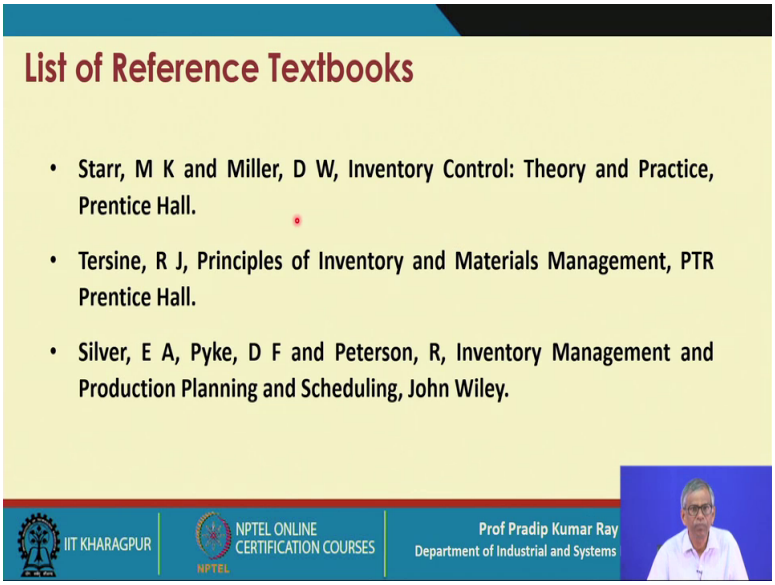
So, the first one is the make-to-order, that means you first get the order from your customer and then you start manufacturing it. End item is customer-ordered unit, ok. So, it should be a, maybe a very specific design.

Next situation could we make-to-stock, that means already you know say the design is known and you just produce it to stock and you know that either today or tomorrow this will be in the sold that means, there is a constant demand. Demand maybe the fluctuating the level of demand may be fluctuating, but there is a demand that means, end item is the final assembly unit.

Assemble-to-order that means, you are not manufacturing it you are getting the items from other sources and you get the order, you wait for the order and then as per the order

requirements you go for the assembling. End item is intermediate assemblies or sub assemblies and fabricated parts.

(Refer Slide Time: 30:03)



So, with this so what we conclude that you know there will be why you go for MRP systems. So, this point is made very very clear. Then what are the primary objectives of MRP systems and in order to create such a systems you need different kinds of inputs and the 3 important inputs you must have.

The first one is the mps or master production, production schedule that you derive from segregate production plant. The second one is the inventory status records or the files, ok. So, you must refer to those. That means, you must create those files called inventory status files. And the third one is that is the product structure code or the product structure records or in general this is referred to as so the bill of material. So, now, in the subsequent sessions we will be elaborating on the MRP inputs, MRP outputs and all those. So, with these I conclude this session.

Thank you.