Management of Inventory Systems
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Lecture – 34
MRP, MRP-II and DRP (Contd.)

So, during this lecture session this is the fourth-one, now, I would explain another the numerical problem.

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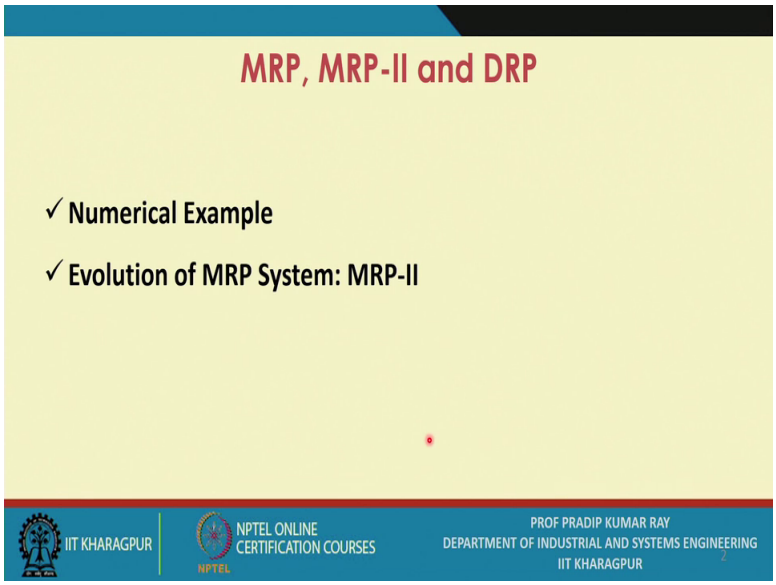

This is a typical the numerical example related to MRP and then we will discuss the evolution of MRP systems particularly the MRP-II. The MRP system in general is made available in different forms and as this situation in the production system the changed over the time so, the MRP system also got changed to different forms. And in today's context we talk about so, the Enterprise Resource Planning or the ERP.

And we also refer to so, the distribution requirements the planning and, but the MRP system is the basis the original MRP systems, later on it evolves into manufacturing resource planning. So, what is manufacturing resource planning we will explain and one point you must note that many companies these days they are been using the ERP, enterprise resource planning. Now, the entire so, the ERP or the enterprise resource planning is based on the logic of MRP-II. Is it ok? So, MRP aspects you must know,

MRP-II also you must know in details. So, that you know you know that why do we use the ERP systems these days.

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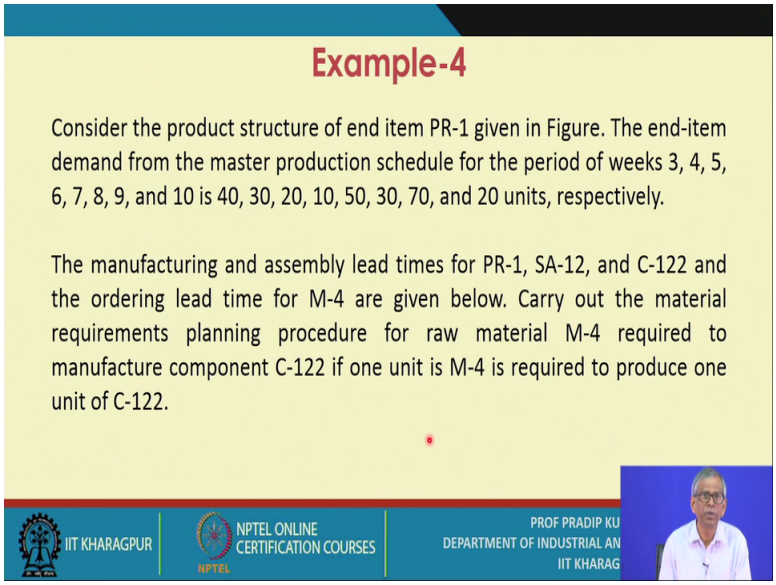

Now, let us take up one particular example and this example the example already we have discussed 3 numerical examples so, this is the fourth-one. Consider the product structure of end item PR-1 given in figure. So, I will show you the figure. So, the end item PR-1; that means, this is the code. So, all the end items are for that matter any item or any say the subassemblies what you find so, there are to be properly coded.

And this is the responsibility of the design department and many a time the process planning department also gets involved. So, it may be the responsibility of the all the process planners also. So, so, any end item or a end product with this you know the code the product structure is given. We will have material in a product structure form the hierarchy that is that is given. The end item demand from the master product production schedule, you already know what is the master production schedule for the period of weeks 3, 4, 5, 6, 7, 8, 9, and 10; that means, from the first third week to the tenth week so, the demand levels are specified.

The gross requirements is 40 units, 30 units, 20, 10, 50, 30, 70 and 20 units respectively at least with these data set you may find some kind of pattern. So, this is very you know it is the particular case. So, as I have already pointed out that the first thing you need to do; that means, you look at the data pattern whether it is a electric or not. In majority of

the cases these days particularly for the end item demand you may come across the erratic demand pattern.

So, the manufacturing and assembly lead times there are two aspects one is the manufacturing part and manufacturing is followed by the assembly; that means, first we talk about part manufacturing. And part manufacturing then you know the followed by the assembly. Now, the lead times for PR-1, SA-12, and C-122 that SA, stands for maybe the subassemblies coded as 12. And the C may stands for the component coded as 122 and the ordering lead time for M-4; that means, maybe the material M stands for the material.

So, you have the subassemblies, you have the component and you have the materials. So, the ordering lead time for M-4 are given below so, this information is given. Carry out the material requirements planning procedure for raw material M-4 required to manufacture components C-122; if one unit of M-4 is required to produce one unit of C-122. So, it apparently it is a simple problem, but if you if you solve these problems so, you will you will come to know the intricacies involved in MRP computations ok.

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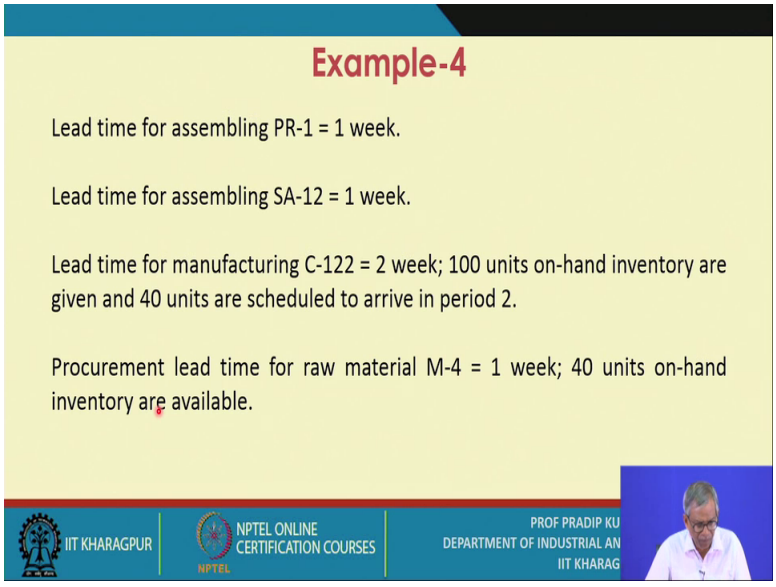

Now, the lead time for assembling that is the PR-1 is 1 week, lead time for assembling subassemblies 12 is also 1 week. So, lead time information is a must and please make a note that we will we will we are assuming that the lead time is known; that means, there could be a fluctuations in lead time. But, here for the MRP systems we are assuming that

the lead time remains constant; that means, this is problem under certainty as far as the lead time is concerned.

Now, this question now this assumption may be questioned. So, later on you may relax these assumptions. So, under certain the conditions you will find in the latest versions of MRP certain you know the statistical analysis also is allowed. Is it ok? Or some kind of say the inferential statistics also you can imply, but that is that extension in order to you know the bring in the concept of mathematical modeling or the statistical modeling ok.

So, that the working of the MRP system becomes improved. So, right now we are we are assuming that the lead time remains constant known with certainty. Lead time for manufacturing C-122 is 2 weeks; 100 units on-hand inventory are given and 40 units are scheduled to arrive in period 2; that means, at time t equals to 0 this is the scenario ok. So, when the entire the plan will be made. Is it ok?

So, procurement lead time for raw material M-4 is 1 week and 40 units on-hand inventory on-hand inventory are available for this material. So, this is the present status at time t equals to t or time t equals to 0.

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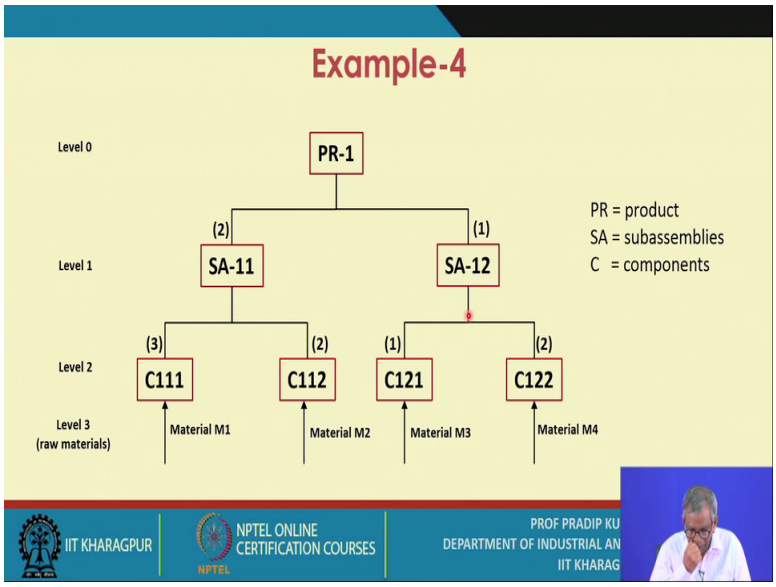

So, this is essentially your the bill of materials. So, this bill of material or the product structure in hierarchy is given by the design department. So, as already I have mentioned

that this is the end item, the code is PR-1, this is level 0. It consists of say the two subassemblies one is a SA-11 and the second one is SA-12.

So, the PR stands for product, SA stands for subassemblies and the C stands for the component ok. So, in order to produce 1 unit of the product or end item you need 2 units of subassemblies 11 and 1 unit of subassembly 12 so, this is level 1. So, for these two subassemblies the parent item is the end product or the PR-1. Now, in order to produce 1 unit of subassemblies 11 what you require; that means, you require component 111 and component 112.

So, for component say C 111 and C 112 the parent item is subassembly 11, we have already used these terms. And to produce 1 unit of subassemblies 11 SA-11 you need 3 units of C 111, component C 111 and 2 units of component C 112 and then this is the level 2. And at level 3 to produce this component C 111 you need the raw material M1, to produce C 112 you require material of type M2; that means, you know its these raw material so, its so, the chemical composition will be specified and including the physical properties.

So, the based on the physical properties required as well as the chemical comp or the chemical compositions required and the comp chemical compositions actually determine may determine the physical properties. So, you select when that where the physical properties as required for this component you select the appropriate raw materials. Similarly, for the subassemblies 12 you need component 121 and component 122, for component 121 you require material of type M3 and for component C 122 you require the material of type M4.

So, C 121 and C 122 both of these items or these components are having the present item called SA-12 subassemblies. And to produce 1 unit of subassemblies 12 you require 1 unit of C 121 and 2 units of C 122. So, this is the explanation of the product structure hierarchy or product structure code or bill of materials. So, you come to know from this explanation that at what point in time which say the component on which the materials you require when the lead time is known. And what is the sequence of the activities or the sequence of operations you say need to say the carryout for getting the final product PR-1.

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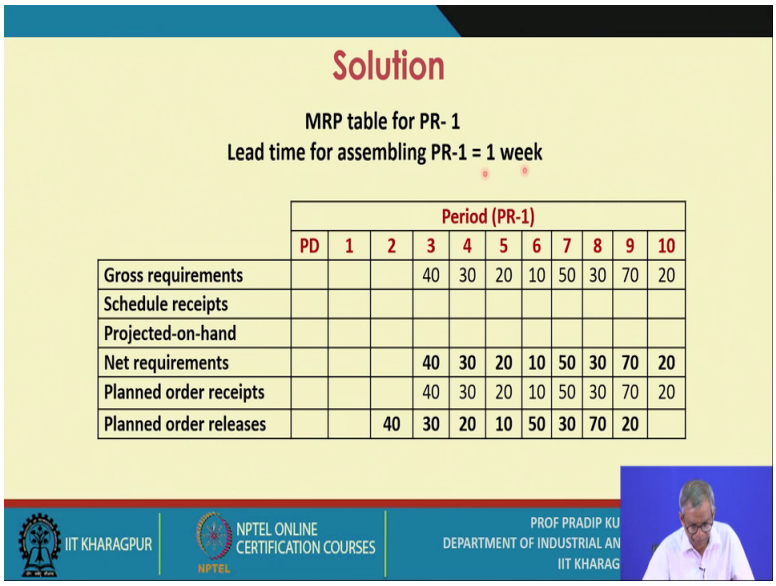

Now, you have all this table who already we have referred to say example 3 and you have come across such a table. So, these are the 4 parameters, we have the gross requirements, schedule receipts, projected-on-hand, net requirements ok, then the planned order receipts and the planned order releases. So, how many the time periods you have considered? You have considered the 10 time periods ok so, 1 2 3 4 5 6 7 8 9 10.

Now, the first the row refers to the gross requirements. So, the gross requirements from the third time period these gross requirements are given already and the net requirements. So, absolutely same as the gross requirements. Planned order receipts is this one and the planned order releases that is this one that means, that is just for; that means, for this item that means, this is for say PR-1; that means, the final or the end product.

And for end product essentially you it is an assembly work and for carrying out the assembly work you need 1 weeks time. So, that is why the lead time is 1 week. So, for each one that means, the planned order receipts this is this and as this is there is say so, in the lack time or lead time of known week. So, the planned order releases will start 1 week before. So, this is the interpretation of this table for the final product PR-1.

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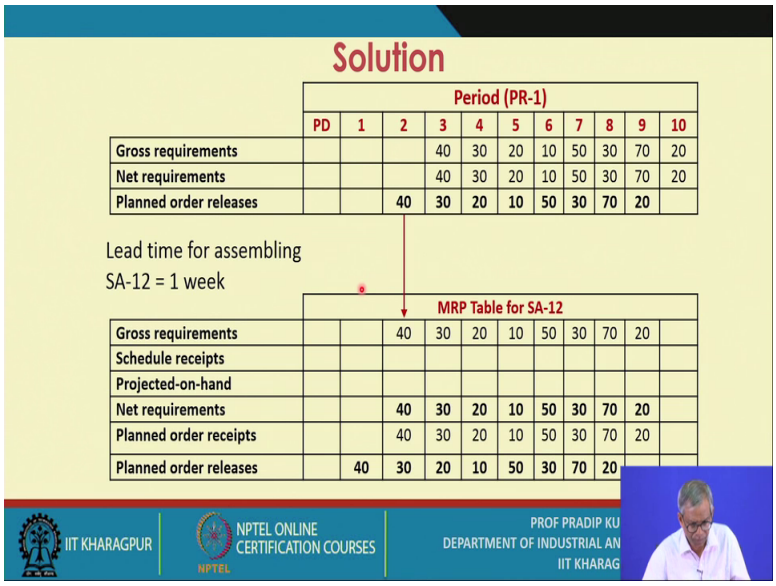

So, now what you try to do; that means, the gross requirements are known, net requirements we have already calculated. And the planned order release is already known 1 week, say before as the lead time is say just 1 week. Now, suppose the gross requirements is 40. So, lead time for assembling SA-12, so, this is 1 week. So, you require these items the gross requirements for our subassemblies 12 and to produce say 1 unit of say the product you require say 1 unit of subassembly 12.

So, this information you get from the say the bill of material say the figure. Now, this is the gross material. So, that is why MRP table for when you create this MRP table for subassembly 12 so, the gross requirements immediately you can calculate same 1 unit. Net requirements will be the same. So, the planned order receives is this much there is no change. But the planned order releases will be on the first time period; that means, the 40 units required on the second say the time period. So, you need to release the orders 1 week before; that means, in the first week you must release the orders of 40 units as the lead time is 1 week. So, this way you calculate ok.

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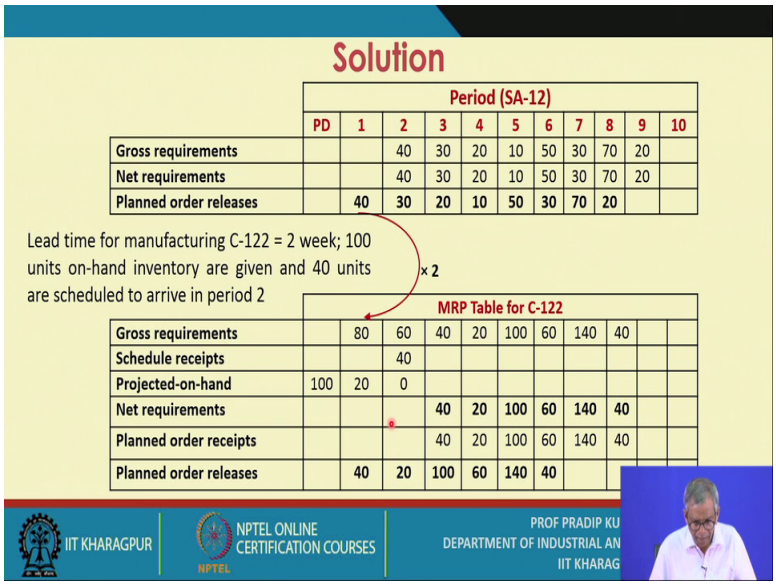

Next you so, you have this period that means, that means, these are the periods in fact, you have and for the subassemblies 12. So, subassemblies 12 is this is the gross requirements 40 30 like this, net requirements remains same. Now, here the lead time is 40 so, this is your say the planned order releases already you completed. A lead time for manufacturing component C 122 so, that is the 2 weeks, 100 units on hand inventory are given and 40 units are schedule to arrive in period 2. That means, here what you require that means, for to produce say 1 unit of say SA-12 that is a subassemblies you require 2 units of C 122.

So, what is the gross requirements? Then the gross requirements is 40 into 2 that is 80, 30 into 2 60. And so, the same way you calculate the gross requirements for the component C 122; that means, at what time you require you require to supply a specific item that is specified. So, the gross requirements in time say week 1 you have 80 60 40 and so on, with the remaining time periods. The schedule receipts is 40 units. So, that is mentioned that 40 units are scheduled to arrive and period 2. So, this is your updated information. So, projected on hand these also mentioned that means, 100 units on an inventory are given; that means, the projected say in hand that is 100 units projected on hand.

So, so 100 units are already there now so, 80 units you require so, you have remaining 20. Now, the schedule receipt is 40 so, 20 that means, 40 units and 40 units is already

you have that means, there is a shortage of 40, but you have a schedule receipts of 40 and the second week. So, you have the projected-on-hand is 0 then the net requirements; obviously, in a week 3 will be 40. In week 4, it will be 20 for component C 122 and for all other weeks these net requirements you can calculate for the component C 122.

So, the planned order receipts will be this one and here the lead time is 2 weeks that is why these 40 units you require in week 3, so, the 2 weeks before you place the order. So, the order must be released in week 1 and if you release in if you release the order in week 1, it is expected that after 2 weeks; that means, in week 3 you will get the receipts of 40 units. Is it ok? So, here what you have that means, 40 units you received 60 units is a 0.

So, you require say the 20 units over here is it ok. So, the 40 units over here; that means, 40 to 60 and 60 into 40 we have. So, you have already 100 units is it so, your 100 60 140 and 40. Is it ok? So, planned order releases will be 20, this will be 20, this will be 100, this is 60, this is 140, this is 40, that is it ok. So, this way you calculate the values of all these parameters for the component C 122.

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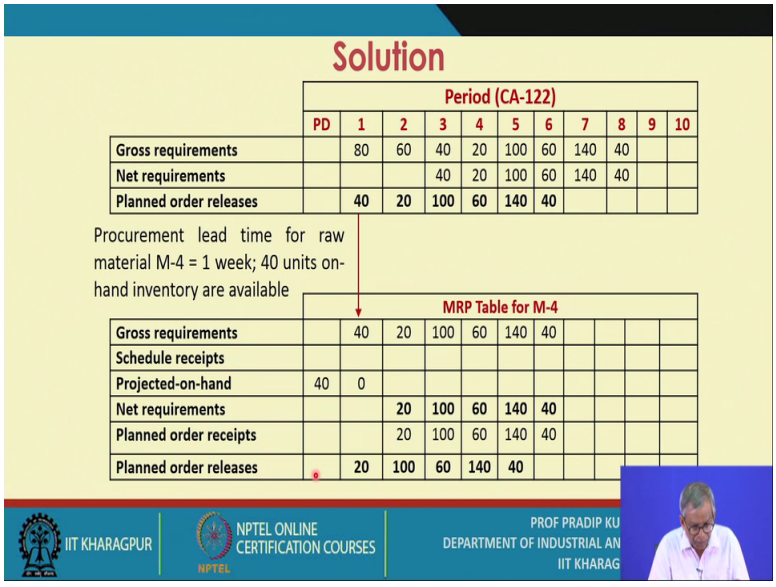

So, similarly what you do; that means, now once this is known now this CA-122 this component is related to say the M-4, you require the materials of type M-4 raw materials of type M-4. So, the lead time for procurement is say 1 week and 40 units on-hand inventory are available for this raw materials. So, what you have; that means, you require

40 units in the first week, second week 20 units, third week 100 units, fourth week 60 units, fifth week 140 units and the sixth week 40 units.

So, the projected-on-hand that is given that is 40 units. So, for this particular problem so, you have now projected on the 40 units are consumed so; obviously, you do not have any units as projected-on-hand. So, the net requirements will be 20 100 60 140 40, planned order receipts will be 20 100 60 140 40 ok. And so, that as the lead time is 1 week so, 1 week before you place an order of 20 units and then the next week you place an order of 100 units, next to next week 60 units and so on ok. So, this way you make a plan for the order releases.

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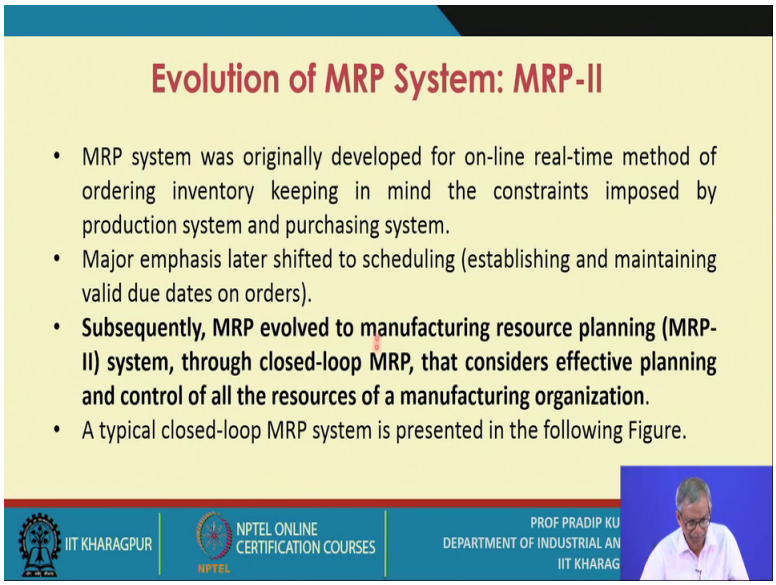

Now, so this is a typical problem. So, you please go through this particular problem and there could be many other kinds of problems you may come across MRP. But the this the 4 kinds of problems, the numerical problems which we have discussed these are very typical and the my suggestion is that you go through these problems. And I am sure that once the concept is made very clear and you understand the computation procedure the remaining matters are very routine. And it is very and the simple and the simple so, the arithmetic calculations you need to do.

So, there are several assumptions and there are certain limitations of MRP systems. So, before you apply an MRP systems in a given situation so, first you check at what extent it is feasible. If it is feasible then only we will go for it, if it is not feasible for the given

item is it so, you assess the present situations. So, and if you find it is not feasible; that means, there are many the data are not were the not the reliable and there is a risk involved.

So, you do not go for the MRP systems so, there are certain conditions to be to be made. Evolution of the MRP systems, MRP-II. Now, before I discuss the DRP I will also refer to MRP-II systems because, originally during mid 70's or early 70's the MRP system was introduced or adopted by several organizations across the globe and the progressive organizations. Now, later on as the situation changes or or the or the assumptions in a real systems which with the assumptions which you made originally for creating the MRP systems.

Suppose these assumptions they never remain valid say the later years so, you need to change the MRP systems. So, so, it has evolved through certain stages. So, the from the MRP systems in initially it was an open loop system then you move to closed loop MRP. And from the closed loop MRP now, we move toward say the manufacturing resource planning which is normally or usually known as a MRP-II. So, the MRP-II in MRP-II, the MRP is known as manufacturing resource planning.

So, MRP system was originally developed for on-line real-time method of ordering inventory keeping in mind the constraints imposed by production system and purchasing system. Major emphasis later shifted to scheduling, the scheduling is the most you know say the difficult part. And so, establishing the proper the scheduling method is a is a is a real challenge. So, a major emphasis later shifted to scheduling, establishing and maintaining valid due dates on orders ok.

Subsequently, MRP evolved to manufacturing resource planning and this is referred to as MRP-II that means, the second version; through the closed loop MRP, I have already pointed out that considers effective planning and control of all the resources of the manufacturing organization. Not necessarily, only the inventory items or inventory systems. A typical closed loop MRP system is presented in the following figure ok.

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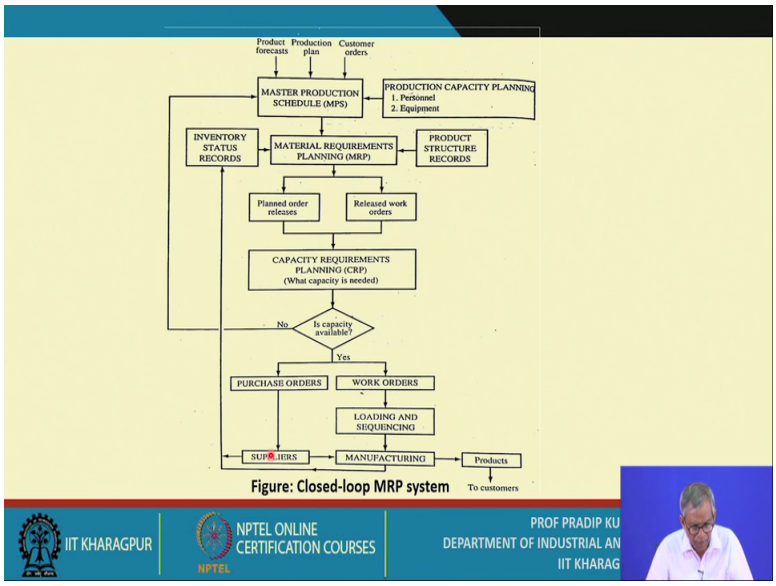

So, MRP so, let me the first explain the closed loop system. Initially, it was it is an open loop systems as we refer to the pictorial representations of the MRP systems, the original MRP systems. So, you conclude that this is an open system. Now, so any open systems you create there is a risk involved; that means, you know you may not have the feed forward the loop or you may not have the feedback loop.

So, it is becomes difficult to so, the correct yourselves and there may be many other kinds of risks. So, it is always better that you opt for a closed loop systems because, all these you know the components in the systems MRP systems they are interrelated. So, let me just the next 2 to 3 minutes of time, let me just highlight the important aspects of the closed loop MRP systems. So, like you have the master production schedule. So, there was the inputs so, inputs are product forecasts, production plan you must know and the customer orders. This point already we have elaborated.

Now, this master production schedule MPS, when you prepare it depends on the production capacity planning. So, the capacity planning for the personnel and capacity planning for the equipment and the facilities, these are the two important issues. And then what you do you go for a material requirements planning, that is MRP. So, you have the inventory status records and you have the product structure records. Then you have two types of the actions outputs, one is the planned order releases and you have the

released work orders. Is it ok? So, this is related to the purchase orders, this is related to the work orders.

Now, with this what you try to do; that means, you have the capacity requirements planning to what extent the, this is the production capacity planning, this is the capacity requirements planning or the CRP. What capacity is needed? This issue you need to consider, this is a very important issue in fact, the capacity planning. So, now, the question is raised, is the capacity available? If it is yes then; obviously, you go for the purchase orders and you go for the work orders. If it is no then; obviously, you need to change the master production schedule because it should match with your you your capacity. Is it ok?

So, the capacity planning is in a very important issue to be considered before you become ready for the MRP systems so, is a closely link. So, in a in a closed loop MRP what you try to do; that means, so the MRP system is linked with the capacity planning systems or the capacity requirements planning systems. So, now if the capacity is available then you go for the purchase orders and you go for the work orders proportionately. And the loading and sequencing this is an important issue work orders; that means, in house production.

So, these two issues are related to basically are the sequencing, loading and sequence is the part of the scheduling the jobs of scheduling or say the whatever, it is a flows of scheduling also you need to consider. And then, but essentially you go for the jobs of scheduling because, I have already mentioned that the MRP is applicable principally for or say you know the repetitive manufacturing. So, now we go through the selection of the suppliers and this is the part of manufacturing and then the products are manufactured and it sent to the customer. So, this is the closed loop MRP systems.

So, whenever you focus on the MRP systems so, but we must have in your mind that that the MRP system is the part of the closed loop MRP systems which is; that means, it is it is it is very much linked with the capacity planning system. So, with this understanding of the closed loop MRP systems, I conclude this session.

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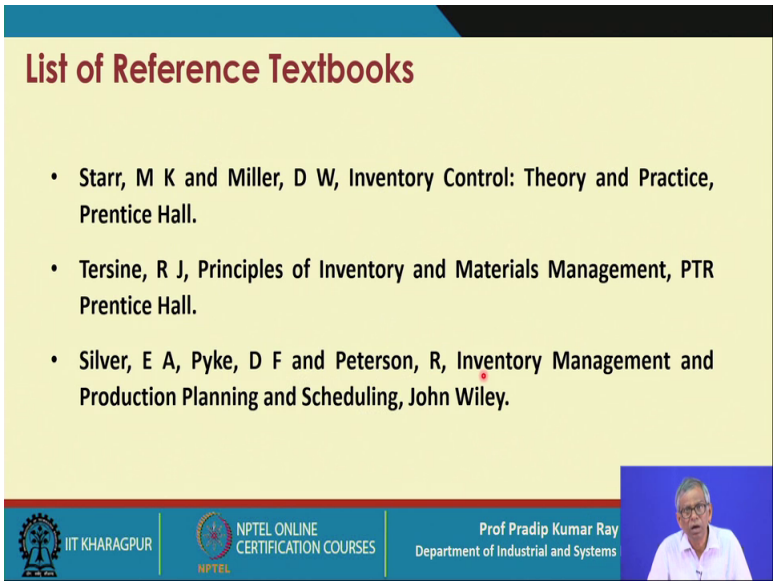

And in the next session I will be discussing of the MRP-II systems, manufacturing resource planning systems and the DRP systems, distribution requirement planning systems.

Thank you.