Project Management for Managers
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Lecture - 34
Project Time Management - Project Scheduling

Good morning friends. I welcome you all in this session. As you are aware in previous session we discussed points related to Project Time Management. And as I said time management is very important knowledge area of project management. And in this in time management area we have seen several processes. And there were 7 processes if you remember in that slide right. So, there were 7 you know processes each process had different inputs different tools and techniques and different outputs.

So, apart from those 7 processors we have seen how to you know monitor up a network, right. And there are different ways of monitoring and controlling a project right. So, we talked about bar chart or Gantt chart, we have talked about life cycle curves LOV and network right. So, there are 2 types of network techniques CPM and pert a CPM is a technique where in the duration of the activities fixed or it is deterministic are known a priory.

Before you start your activity, while pert network is a network where you have got probabilistic time estimates. And we have seen how to draw a network right. So, you have got activities you have got nodes and you have got dummy activity.

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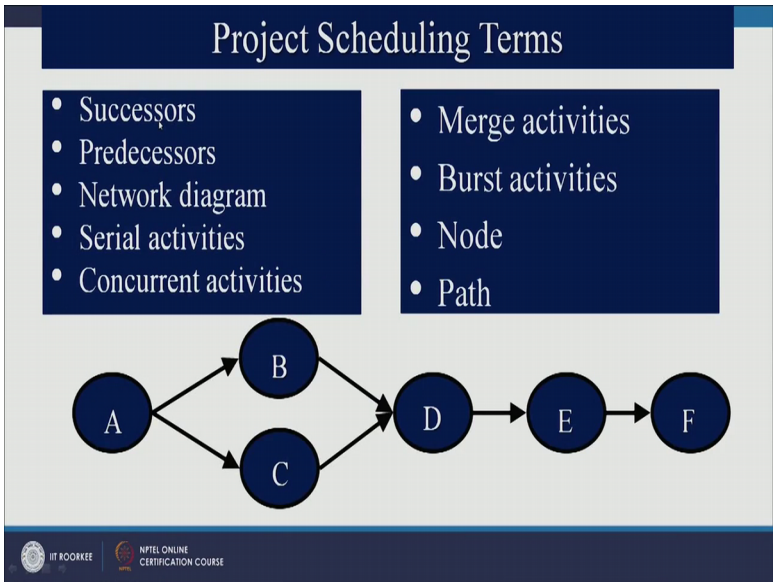

So, let us look at project scheduling terms once again. So, you have got successors you have got producers you have got serial activities, you have got merge activities, burst activities, nodes and different paths.

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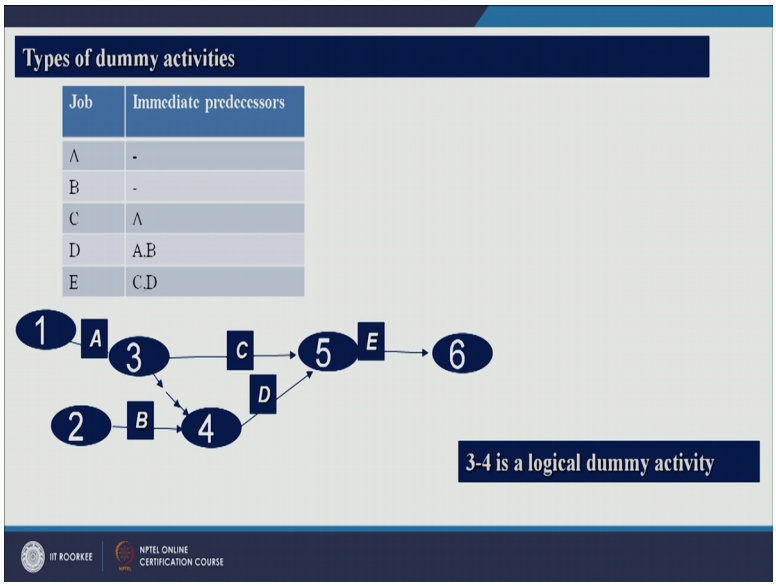

So, let us move on to next slide type of dummy activities right. So, let us look at this network, very simple network. Activity A job A immediate predecessor no So, activity A is the first activity in this project, right. Activity B or job B it is immediate predecessor or nothing right. So, activity B is also an activity which is I will also first activity similar to

activity A, right. If you look at job C, right. This one job C. Immediate predecessors is a. So, for job C is here job C is here, right. Or activity C is this one 3, 5 activity C. Immediate precedes predecessors are A and B, right. Just see A and B, right. Actually this A this B is connected with C through this dummy activity.

Similarly, activity E predecessors is C and D right. So, for activity E predecessors are C and D right. So, in this way you can prepare a network. And this activity is dummy activity; it is called logical dummy activity right. So, why did we use this dummy activity here? Because we want to know or we want to connect A and B with D; if you look at this job D job D it is immediate predecessor are A and B right. So, this is A and this is B, right and this is successor activity. So, this is nothing, but a logical dummy activity, right. Now apart from logical dummy activity you have got one more type of dummy activity it is called, we use dummy activities for unique representation of parallel activities right.

So, apart from logical dummies one may be face with a situation where 2 or more activities have identical sets of predecessors and successors right.

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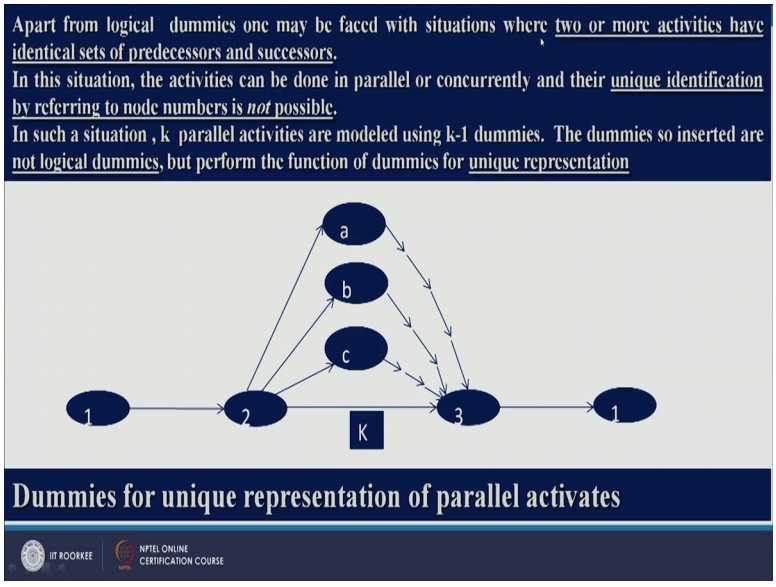

So, you can have 2 or more activities having identical sets of you know predecessor and successor. Now what to do in situation like that right? So, in such activities can be done in parallel or concurrently and their unique identification by referring to node numbers is

not possible right. So, you cannot identify those activities through node numbers right. So, what we do K parallel activities are modelled using K minus 1 dummy activities.

So, these are K minus 1 dummy activity the dummies. So, inserted are not logical, but perform the function of dummies for unique representation right. So, this is a major difference between logical dummy activity, and dummy activity which we use for unique representation.

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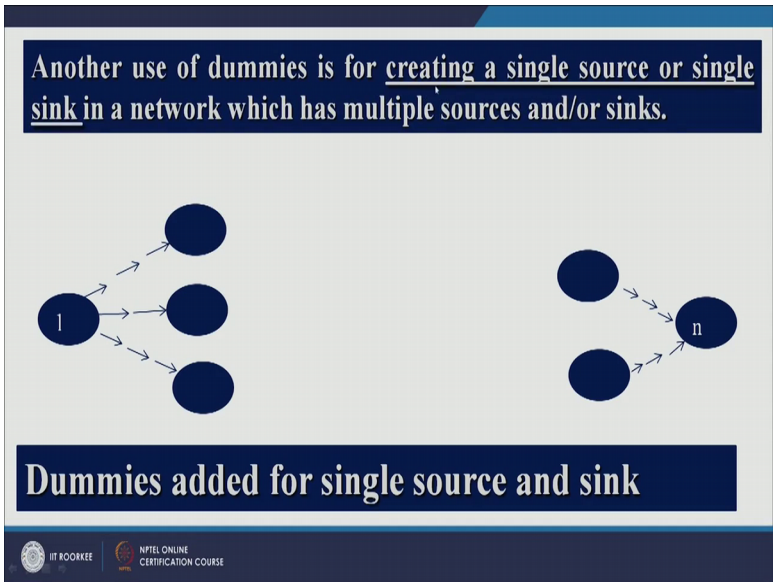

So, let us look at another use of dummy for creating a single source or single sink in a network which is multiple sources and multiple sinks. So, let us say this is your event and these are different dummy activities right. So, you can create multiple sources. In as shown in this network and these are multiple sinks right. So, we can use dummy activity for creating single source or single sink.

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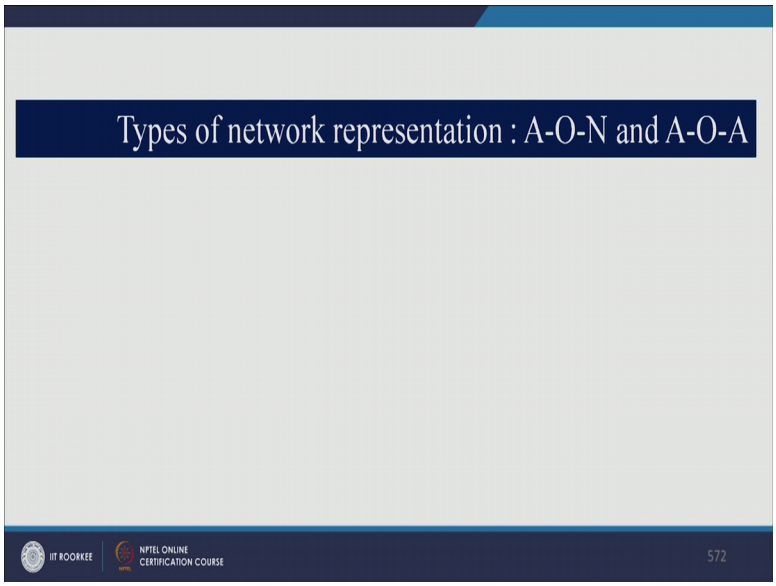

Now, I have talked about network representation techniques, there are 2 techniques activity on node and activity on arrow, right. Let us look at through some examples.

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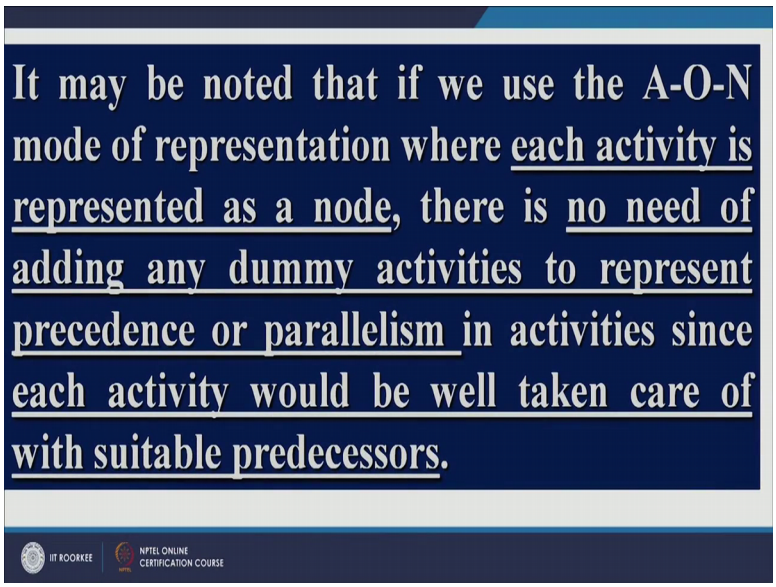

It will be N In fact, the major difference between these 2 is that in activity on node type of a representation we do not use dummy activities right. So, let us look at this slide it may be noted that, if we use activity on node mode of representation where each activity is represented by a node right. So, there is no need of adding any dummy activity to represent precedence relationship.

Why? Because each activity is getting represented by a node itself right. So, there is no need to have a dummy activity. And this precedence relationship is well taken care by activity on node type of representation. So, we are looking at different you know rules of drawing networks right. So, we have already seen 2 rules the first one was, I will show you once again the first one was each activity must be represented by one and only one arrows.

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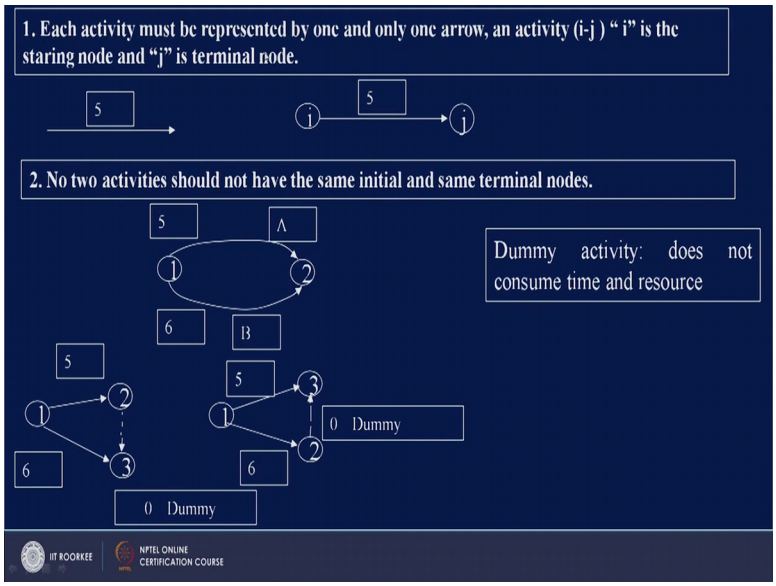

Second one was no 2 activities should have the same initial and same terminal road this is wrongly written here, right. This is you just delete this one, right ok.

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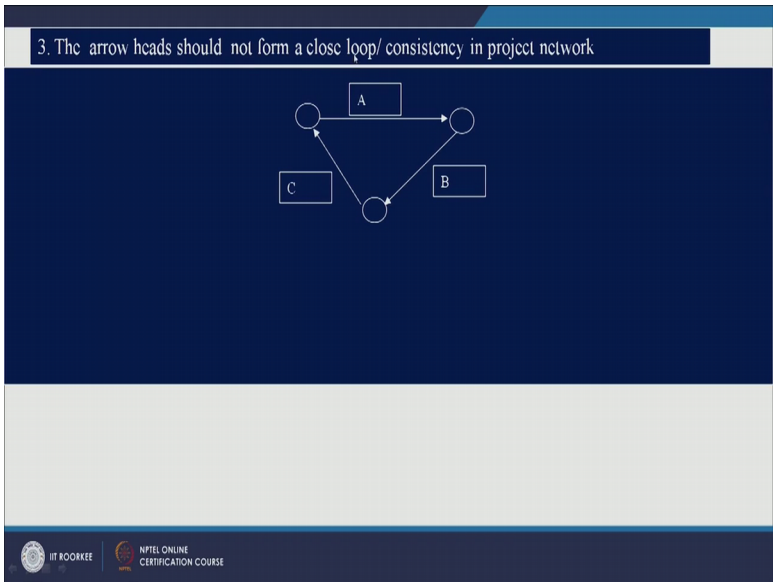

So, let us look at third point. The arrow based should not form a close loop, right. In a network you should not have closed loop, right. I will tell you with an example. Let us say there are there are 3 activities.

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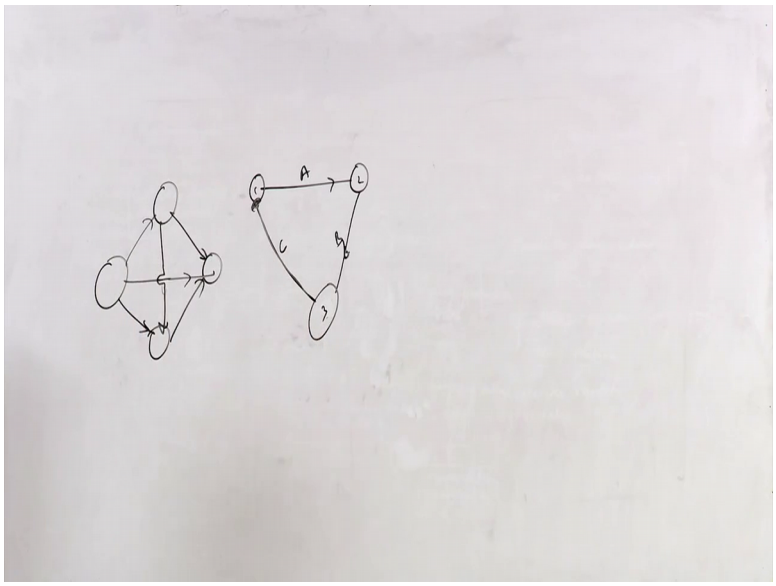

Let us say activity A starting here ending hear activity B. So, what we are saying that activity B depends on Activity A. So, unless and until you complete activity A you cannot start activity B, right. This is activity B, right. Let us say these are different nodes 1 2 3 now you cannot have a situation like this activity C. You can start activity C once

you complete activity B; now when you say this when you say this activity 3 1. Now what you are saying? Activity A you cannot start until you complete activity C. So, how it is possible isn't it? Is it is not possible at all. So, to avoid a situation like this you need to introduce dummy activities.

So, this is closed loop or consistency in project network, you know there should not be any closed loop and they should be consistent in the project.

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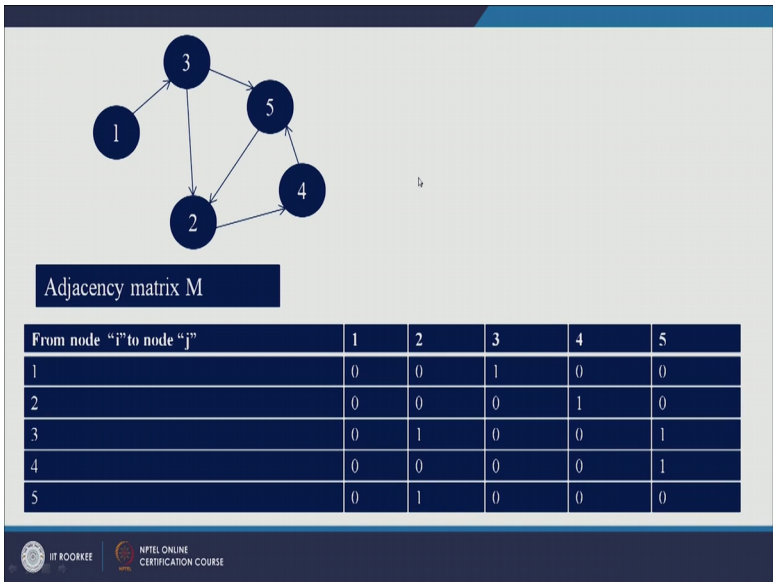

From node "i"to node "j"	1	2	3	4	5
1	0	0	1	0	0
2	0	0	0	1	0
3	0	1	0	0	1
4	0	0	0	0	1
5	0	1	0	0	0

So, you have got activity A B and C right. So, how to find out closed loop in a network? Very difficult task; in a small network like this you can easily identify whether closed loop is there or not, but let us say in large network you have got let us say hundred hundreds of activities and let us say hundreds of nodes right. So, you cannot easily identify a closed loop.

As far as this particular node is concerned you can identify a close loop. Is it possible for you? Just look at this network carefully. Can you identify closed loop? Is it is it there? Yes I think there is closed loop and closed loop is like this that is a is 4 to 5, 5 to 2. So, this is a closed loop right. So, because since this is quite a small network you could easily identify close loop, but in a large network you need to have some scientific method of identifying closed loop.

So, let us look at what is that matters right. So, first of all you should prepare an adjacent matrix right. So, this is your matrix, which you have prepared from this particular network right. So, in this network if you look at there are 5 nodes right; so 1 2 3 4 and 5- this 1 2 3 4 4 and 5 right. So, let us find out how these nodes are connected; what is the relationship between these nodes right; so from node i, node J right.

So, let us say 1 2 3 4 5 and 1 2 3 4 5 right. So, is there any connection between node 1 and 2 here. It is a first 1 and 2, right. 1 and 2 there is no connection; so 1 2 2 0, right. 1 1 2 2 3 3 4 4 5 5 will always 0 right. So, is there any connection between 1 and 2 node? No. There is no connection, right. Is there any connection between node 1 and node 3? Yes there is a connection, this one. Is there any connection between 1 and 4? No connection 1 and 5, no connection.

Similarly, is there any connection between 5 and 2? There is a connection, right. Isn't it? Is there any connection between 5 3, 4 and 5 no, there is no connection. So, first of all prepare adjacency matrix, like this, the next step is take square of this matrix, right. Or find out N square value. You just multiply this 5 by 5 matrix with the same matrix right. So, you will get M square right.

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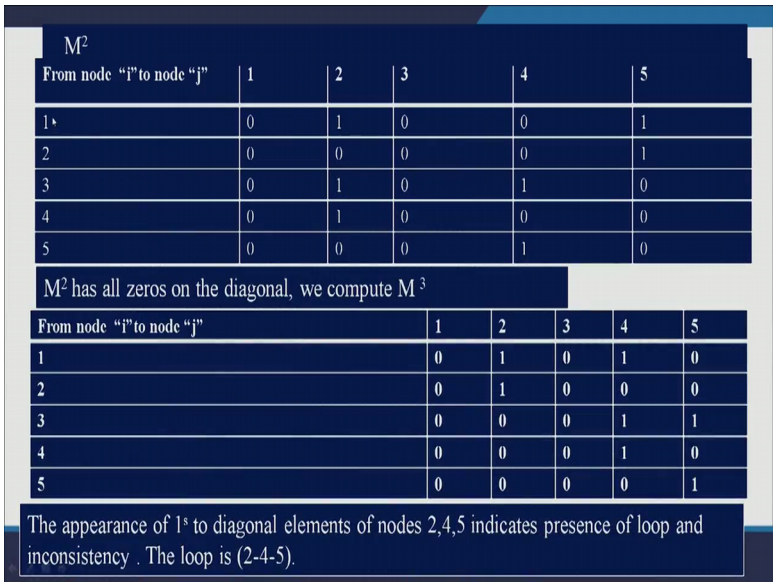

So, this is this matrix is nothing, but M square matrix right. So, you have got all 5 nodes here and all these 5 nodes here right. So, when you multiply M with M you will get M square, right. Just see this.

So, if you look at M, M square matrix M square is all zeros on diagonal, right. There is no one value in all these you know diagonal cells, right. Since there is no one value here in these diagonal cells will calculate M cube right. So, the next matrix is M cube. So, M square you are you are already having multiplied with by M, right. You will get M cube right. So, if you look at M cube matrix. If you look at these diagonal cell this value 1 here 0 here is 1 here it is 1. So, how do you infer from M cube?

So, if you look at M cube the appearance of 1, right to diagonal elements of nodes 2 4 and 5, right. 2 4 and 5 indicates the presence of loop in that particular network, right. Or in other words will say this network is inconsistent right. So, what is the loop is 2 4 and 5. How did we come to know this? Because there is a unity value or value 1 across diagonal cells right. So, this is how you can identify whether a network is consistent or inconsistent, right. If there is a loop it would be called inconsistent, right otherwise consistent, so a better method to identify closed loop in large networks. So, let us find out how to draw a network right.

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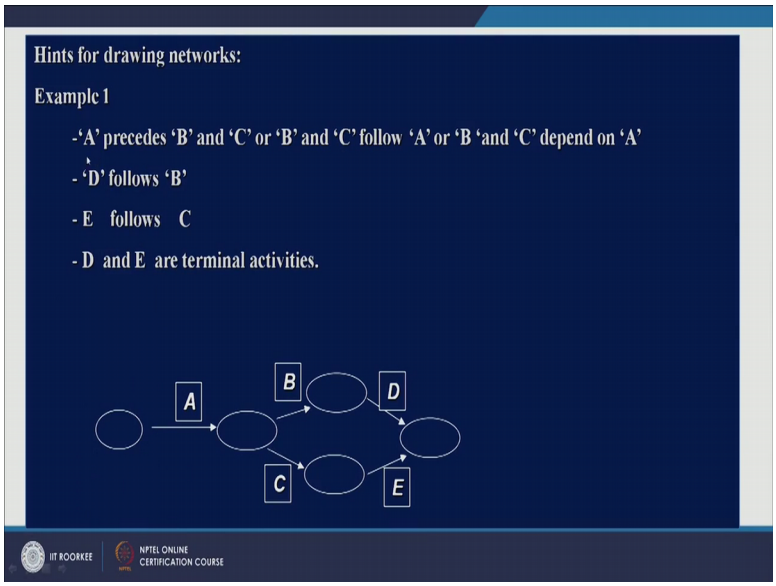

So, let us take first example and the problem statement is like this A proceeds B and C. Now you can rewrite the same point like B and C follow a right. So, when I say a proceeds B and C it means A is the predecessor activity in B and C are successor it takes activities, right. Or I can also say B and C follow A. So, A is the proceed producer activity and B and C are succession activities. Or I can also say B and C depend on A

right. So, first you need to complete activity A and then B and C would start right. So, so you can have different types of you know representation.

So, either you say A represent B and C are, B and C follow A are B and C depends on A one and the same thing, right. D follows B right. So, in this network if you look at A precedes B and C A precedes B and C, D follows B, right D if following B right. So, these predecessors activities these successor activity; E follows C. Yes just seen this E is following C, right. D and E are terminal activities just see activity D activity E are terminal activities.

So, in this way you can draw a network, because if you do not draw a network you cannot calculate the exact duration of the project and different other parameters of the project. Let us look at this particular example right. So, what is the example A and B start immediately. So, you just start activity A and B, you start preparing you just take a pen and pencil pen and note book and start preparing network.

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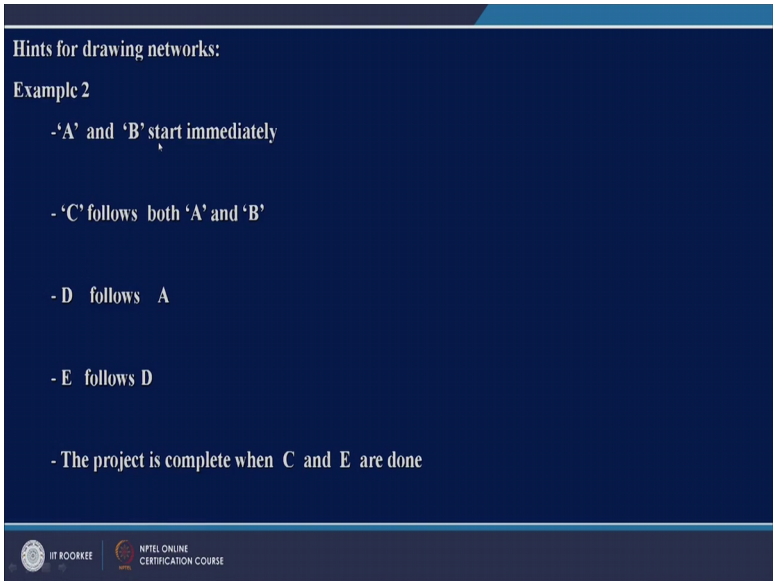

So, A and B starts simultaneously C follows both A and B just draw a network; so A and B starting. So, you just A and B and C is following A and B right. So, C just draw activity C F follows a right. So, after a there would be D activity and E follows D. So, after activity D there would be activity E. The project is completed when C and D are done right.

So, let us see how this network looks like, just compare your network and my network. This is the answer, right. A and B start immediately right. So, they are starting simultaneously, right. C follows both and B just see this s C which is following A and B right.

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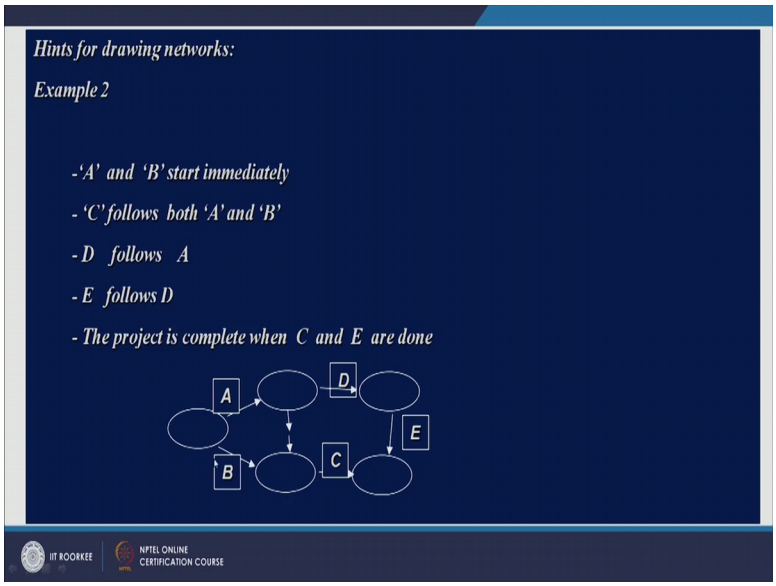

Since you cannot have a network from here to here and here to here, because if you draw that that would be violation of rule right. So, you should use a dummy activity, right. Then D follows a activity D is following A, right. E follows D yes activity E is following D, right. The project is complete when C and D are done right. So, with C and E are done project is complete right. So, this is example 2. Let us look at third example on how to draw a network.

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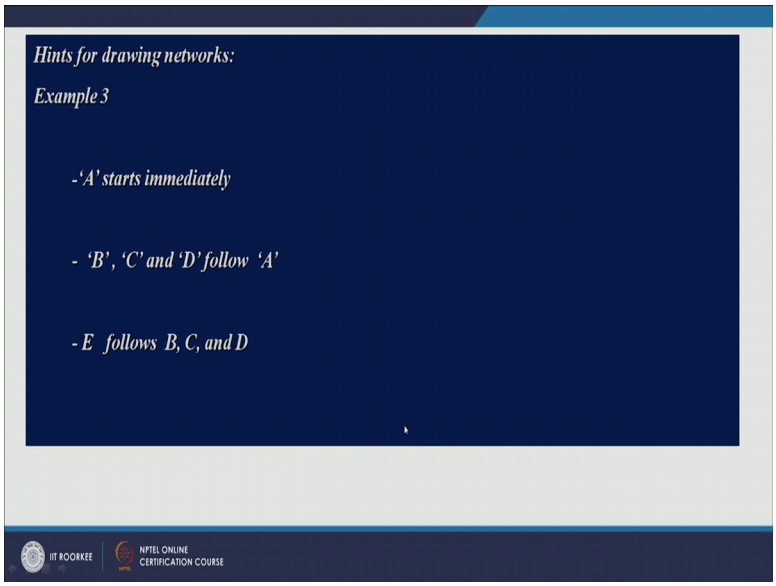

A starts immediately right. So, the first activity is A B C and D follow a need to draw network very carefully. So, B C and D follow A, right. E follows B C and D. So, just draw this network, I hope that you would have drawn a network for this example, right. Let us compare your answer with my answer, right. A let me tell you there is there is it is not necessary that my answer matches with your answer, right.

You may have a different way of representing activity a network. I may have different way of drawing a network right. So, you may use 2 dummies my network in my network I may use one dummy activity right.

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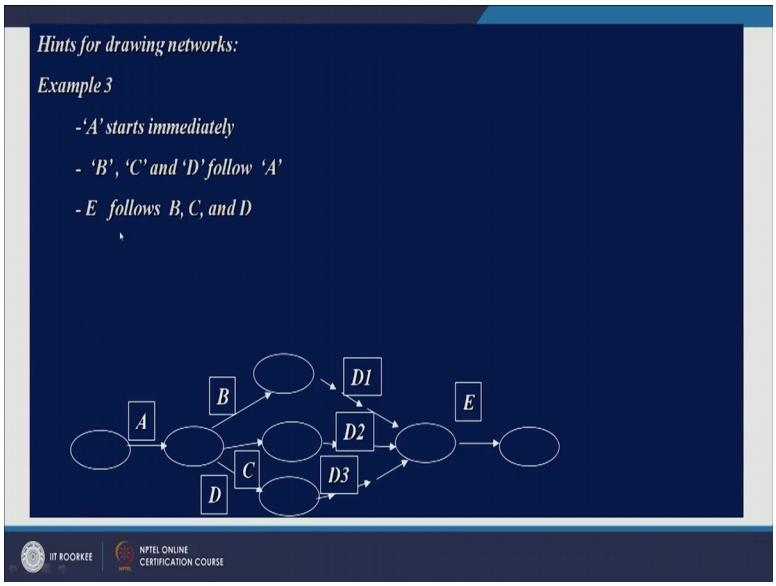

So, try to minimize use of dummy activities in a network right. So, this is how you can draw right. So, A start, A starts immediately this B C D follow A, right. Activity B C and D right. In fact, if you wish you can enter your node numbers also I will tell you how to how to do you know number this nodes. Then E follows B C D, right. Activity E is following B C D right, but you have used 3 dummy activities D 1 D 2 and D 3, right. This is one way of representing network, right. You could have used another method or another way of representing same network right.

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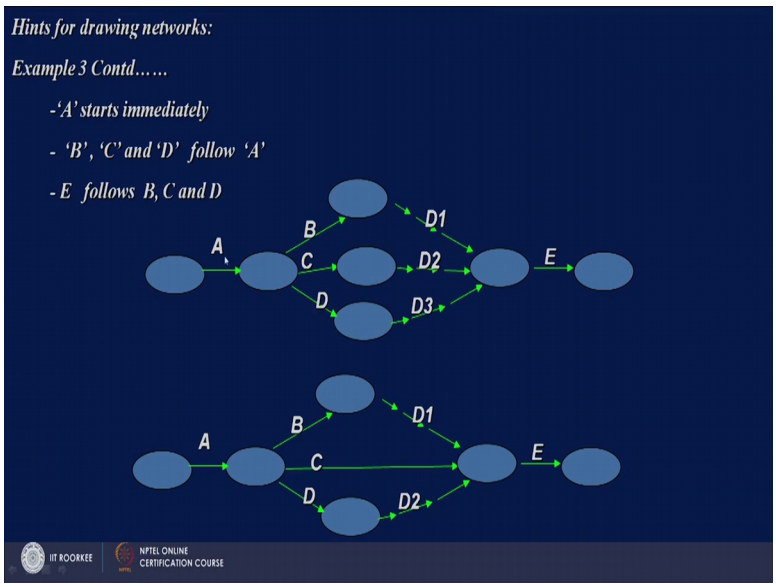

So, this was our first answer; for this particular question, right. You could have done this also right.

So, a starts immediately B C and D follow A, E follows B C E D and D. E is following B C and D. So, in this way I have reduced one dummy activity right. So, I would say this one is better network.

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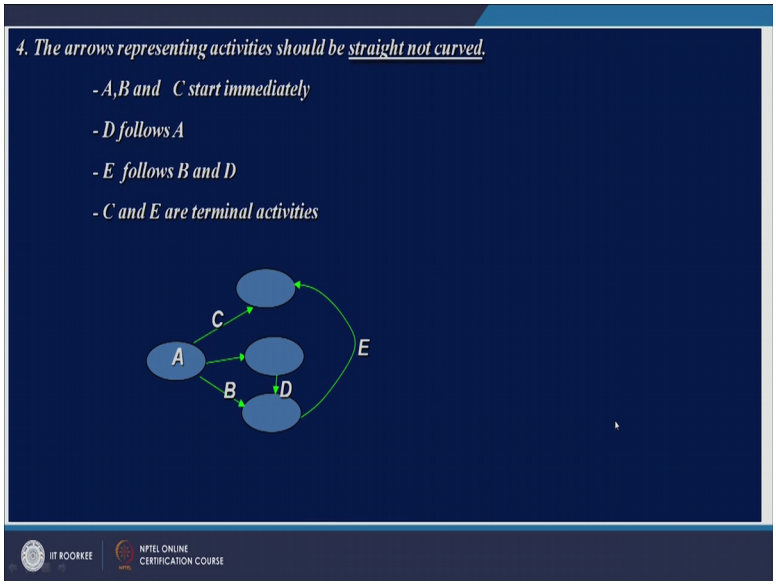

Let us look at some more examples. Let us the fourth point is the arrows representing activities should be straight not curved. Try to use straight arrows whenever you draw any network. Let us say A B, A B and C start immediately; so A B. So, this is this is actually this is actually A, this B and this is C, right. It is up to you can have used this as A B and C not a problem, right. E follows B and D E follows B and D.

So, this is this activity B this is activity B D, right. And E is following them. C and E are terminal activities. C and E let us see this is activity C this is activity E are terminal activities, right. Are the last 2 activities, right? Terminating at this particular node right, but you have used this curved arrow, right. Do not use curved arrows in network right. So, how to avoid a situation like this? Can you draw a network where you do not have this, curved arrow I hope you would have drawn a correct network. Let us see this.

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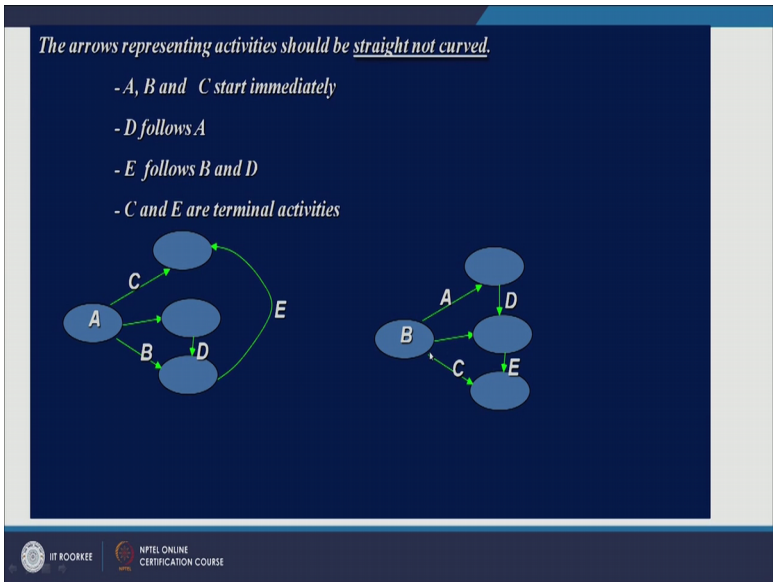

This is a correct network right. So, A B and C this is D and E right. So, this is a better network, right. Try to use straight arrows not curved arrows right.

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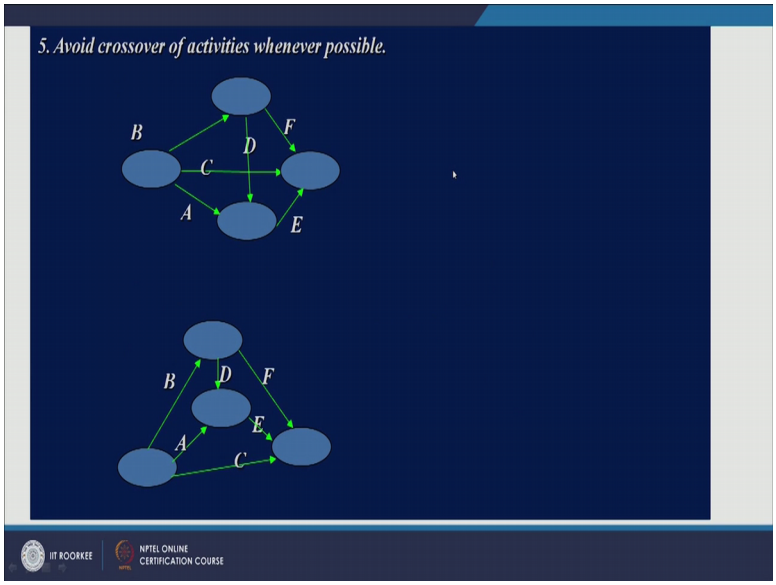

Avoid crossover of activities whenever possible, right. Just look at this, in this network activity D and C are crossing each other right. So, try to avoid a situation like this, right. If not if not possible then you can you know, you can have a situation like this. For example. Let us say if you have a network like this right. So, rather than having a situation like this you can do one thing just use this sample, right. You can do this kind

of, you can you can write you can convert just you know cross section into this type of situation.

If possible try to avoid if, but if you do not if you are not able to avoid then you can over situation like this, right. Now there are couple of examples on how to construct a network. Let us look at this example and B are the first activities of the project start simultaneously.

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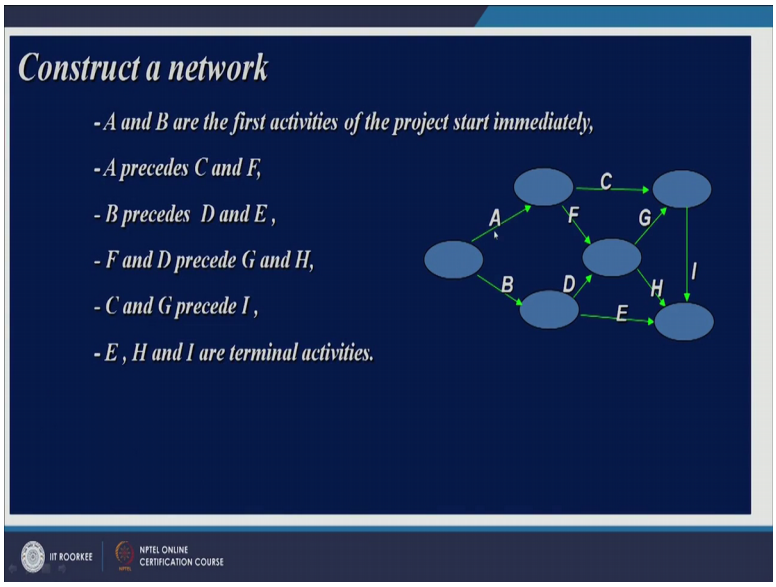

So, there is one node A and B are starting simultaneously A proceeds C and F. So, C and F are following activities of A, right. In other words C and F follow activity A. B precedes D and E right. So, D and or in other words D and E follow B. F and D precede G and H right. So, first you have got F and D and then you have got G and H, right. C and G precede I, E H and I are terminal activities. So, all these activities are you know coming at one particular node it is called sink node right. So, just try to draw this particular network.

I hope you would have drawn this network. Let us see whether it is. Or wrong, this is the one. So, A and B are the first activities as I said, there would be one node we can call these 2 as burst activities right. So, from one node you are you are having multiple activities coming out of it right. So, and B are first activities a proceeds C and F. A precede C and F, right. C and F, B precedes D and R right, A and R, right. F and D

precede G and I, right. F and D, right. F and D are the previous activities and G and H are successive successor activities.

C and G precede I write, this C and G are preceding I, E H I and I are terminal activities, right. It is also known as sink node right; so E H and I; so this how you can construct a network.

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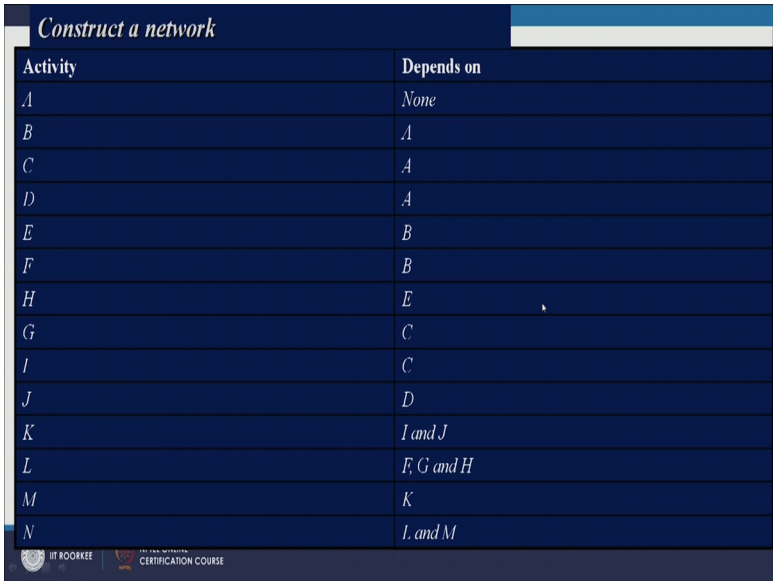

So, this is an example just try to construct a network for this example. So, you have got different activities. So, activity A it does not depend on any other activities; activity B, right. Depends on Activity A, activity C depends on Activity A, D depends on Activity A and so on, right. If you look at this one activity K depends on these 2 activities I and J activity L depends on 3 activities F G and H. Last activity N depends on L and N. So, just try to draw a network I hope you would be able to draw network.

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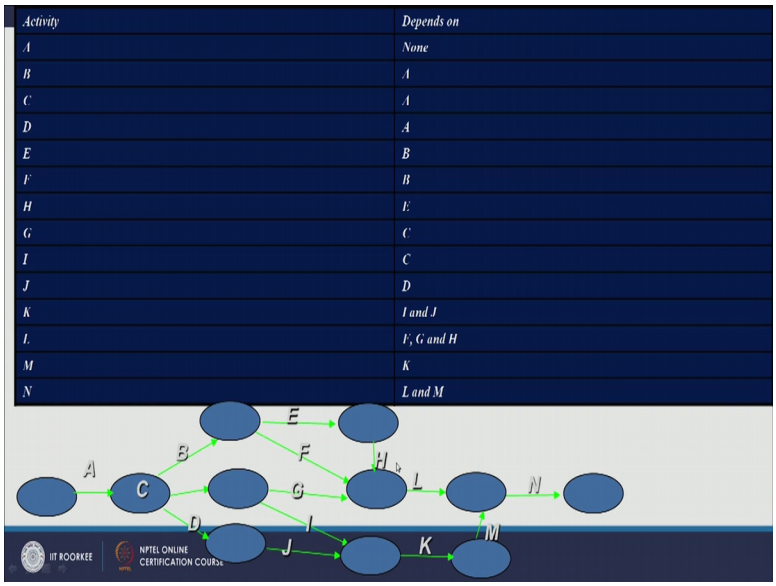

Let us see how it looks like. So, I have drawn this network here itself right. So, activity A activity B depends on A right. So, it activity B depends on A C of course, this is activity C. It is again depending on A activity B again depending on A right. So, B C D all these 3 activities depend on A, right. And similarly you can see other activities. Let us look at this one, right. Activity K depends on I and J. So, this is activity K it is depending upon I and J.

So, unless and until you complete I and J you cannot start activity K which you can see in this network, right. What about this activity L depends on F G and H? Activity L which depending upon F G and H; so this is F, this is G, and this is H which means we have drawn a correct network right.

Similarly, this is the last activity which is M right. So, you just do practice on how to draw networks and there are several books available on project management. Towards the end of towards the end of this particular subject, and in last session I will give you all the references which I have been using in this particular course right. So, let us look at some more points related to activity on arrow and activity on node based network. So, let us say you are moving from your old house to new house, right. And in doing this you need to perform several activities. So, you need to look at several houses, right. You need to review houses.

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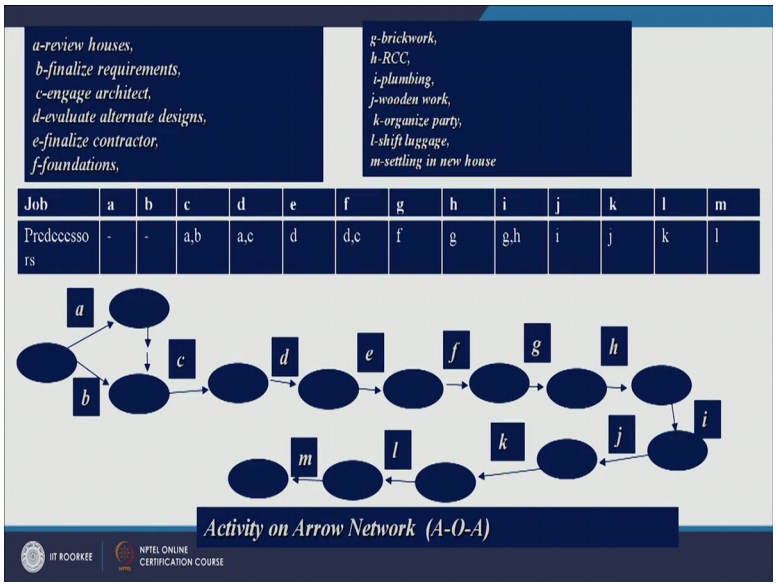

Then finalize your requirements engage architect if needed evaluate alternate design. So, you will have different houses having different designs, right. Finalize contractor foundation then brickwork RCC work plumbing will be there, wooden work will be there, organize party, housewarming party, shift luggage and setting, settling in new house right. So, let us say these are couple of activities of a project when you are shifting from old house to your new house right.

So, you can prepare a precedence relationship right. So, these are different activities, right. A B C D and I have I have you know, written what these activities are right. So, first you just draw a precedence residence relationship network. So, this is activity on arrow network right; so A and B. So, A is reviewing house and your simultaneously finalizing requirements, right. Activity C engages architect and then D E and so on, right. Finally, settling in new house; so this is activity on arrow type of network wherein this is your dummy activity. You can prepare a network diagram for example, using activity on node type of network representation technique. And we have seen couple of examples on activity on node type of networks.

So, you will have a similar network without dummy activity right. So, let us look at we will take the same example, here what is the difference between these 2? Here activities are represented on nodes and the arrows represents the. Precedence relationship right. So, this is the major difference between activity on node and activity on arrow.

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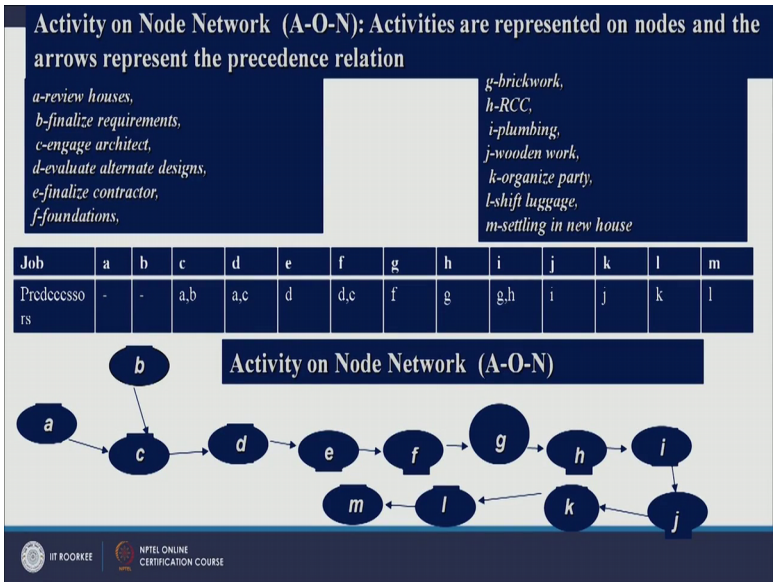

Let us look at solution to this question, just see this is activity on node. So, we have represented all the activities of this question on nodes. So, these are different nodes for activity, activity on node this activity on node this and so on. This does node have any dummy activity.

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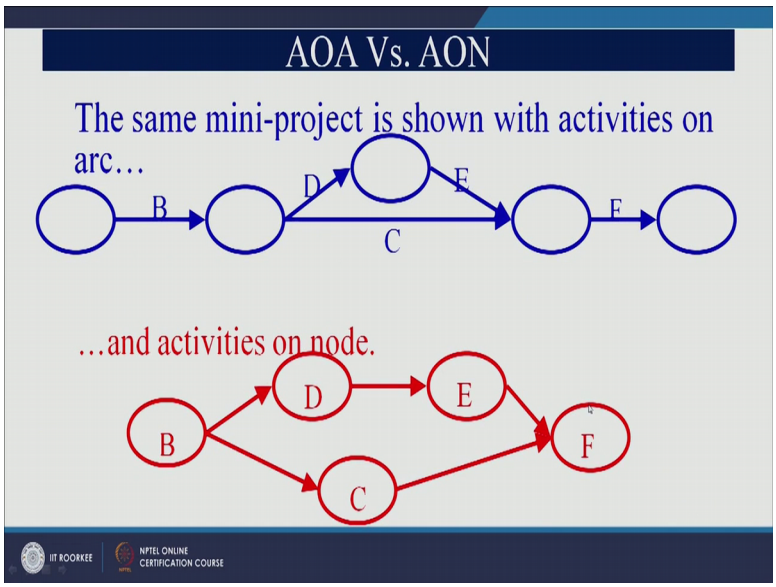

So, this is another example on activity on arrow this is activity on node right. So, we have seen couple of examples on activity on arrow and activity on node.

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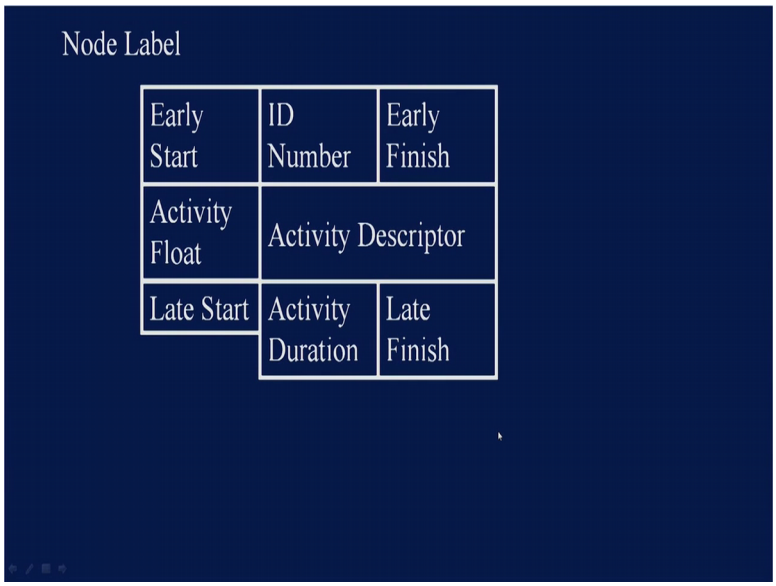

Now, in a in a network you should have different types of you know representation; how do you label a network? Because in a network you have got different nodes and different activities.

In the next class I will talk about how to label different nodes and activities and duration and resource requirement on a network right. So, we will see this point this particular point in next session.

So, with this thank you very much in next class we will start, how to, how to you know number different nodes and some more points in details.

Thank you very much.