Structural Reliability
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Lecture –116
Representation of Systems (Part -20)

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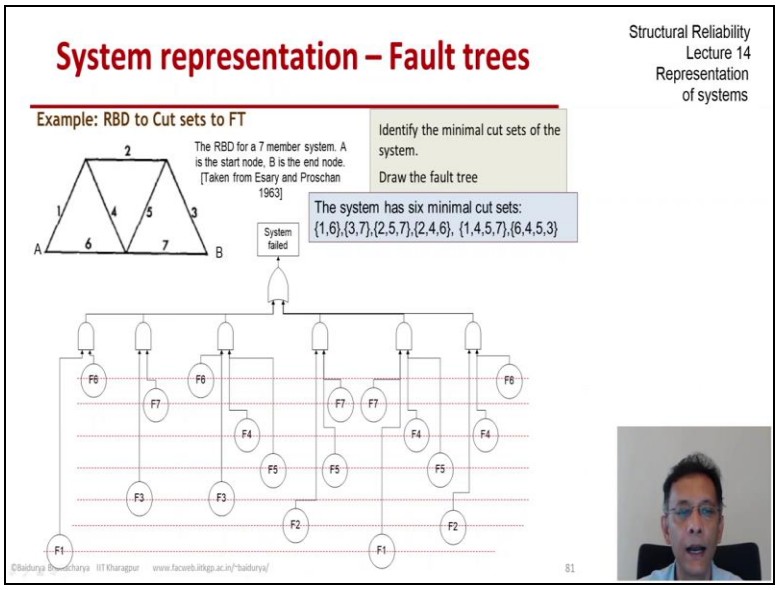

Let us look at 1 more example of fault trees involving repeated elements this is an RBD starting from A and ending at B. So, there are 7 elements and we let us first create the minimal cut sets and then from there we can create its fault tree. So, an inspection reveals that if we cut any 1 element for example it is not going to lead to system failure. So, what if we cut; 1 element 1 along with element 6.

So, that indeed would stop the flow from A to B. So, the RBD helps us clearly identify 1 of the minimal cut sets 1 2 1 and 6 likewise the next 1 we could see by inspection would be 3, 7. So, if 3 and 7 are both failed then obviously there is no path from A to B. This way if we proceed we would figure out that there are 6 minimal cut sets for the system these would be the first 2 that we have already identified 1, 6 and 3, 7 along with that there are 2 which have 3 elements and then another 2 which have 4 elements.

So, the task here is to identify the minimal cut sets and from there to draw the fault tree. So, now

that we have identified these 6 minimal cut sets let us remember that a cut set basically a minimal cut set is a purely parallel arrangement of its elements and these minimal cut sets themselves are arranged in series. So, that interpretation lends nicely to the creation of a fault tree. So, let us let us take up these 6, 1 by 1.

So, the top event is system failure and that can happen in terms of a series of minimal cut sets. So, that is why we have the or gate and let us start from the first one 1, 6. So, they are arranged in parallel. So, they are going through an and gate. So, F1 and F6 go through the and gate and then to the or gate leading into system failure. The next one1 is 3 and 7. So, likewise we create the next and gate and. So, on the next is 3, 4, 5 and 6 and then 2, 5 and 7 and then 1, 4, 5, 7 and then finally 2, 4, 6.

So, here we have all the 6 minimal cut sets within themselves arranged as a parallel system and the 6 cut sets are arranged in series. So, 1 6, 3 7, 3 4, 5 6, 2 5 7, 1 4, 5 7 and then 2, 4 and 6. Now you see that all these 7 elements actually have been repeated across different minimal cut sets. So, and that's the reason that i have drawn these elements in a certain manner. So, 6 we had a dashed line connecting the repeated elements.

So, it is going to be a bit cumbersome to do it here but we have kept them at the same level. So, 6 F6 it is easy to identify that they are together F7 appears thrice F4 also appear thrives F5 appears thrice F3 appears twice F2 appears twice and F1 also appears twice. It would be an interesting exercise to see if it would be possible to have a more efficient representation of the fault tree for the same system.