Structural Reliability
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Lecture –148
System Reliability - Time Defined (Part - 04)

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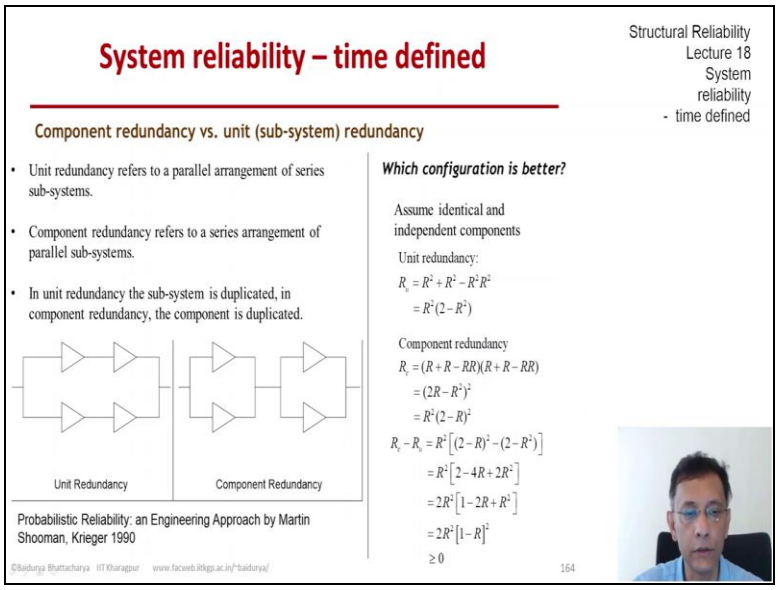

After looking at series and parallel configurations let us look at an interesting mix of the two. So, it is called component redundancy and unit or subsystem redundancy. So, when we talk about unit redundancy it is a parallel arrangement of series subsystems and when we talk about component redundancy it is a series arrangement of parallel subsystems. So, graphically with two by two units this is what the two configurations look like.

So, in the unit configuration we have two subsystems in parallel the upper arm in the lower arm and in the component redundancy we have two parallel subsystems in series, so, the left subsystem and the right subsystem. So, now the question naturally arises is which configuration is better. So, in the unit redundancy the subsystem is duplicated and in component redundancy the component is duplicated.

So, let us just do a small example involving these four elements in these two configurations and

let them be identical and independent. So, in that case the unit redundancy system reliability would be would be each arm has a reliability of R squared because they are in series and because the two units are in parallel. So, it is R square plus r square minus the product of the two.

So, when we simplify when we simplify it is R squared times 2 minus R square and the component redundancy system reliability is each of the two subsystems are parallel in nature. So, that is R + R - R squared and. So, there are two of them. So, we multiply those and the answer is R squared times 2 - R whole squared. Now to find which one is better we just subtract one from the other. So, let us subtract Rr u from R c and if we do the algebra the answer comes out to be that the difference is a product of non-negative terms.

So, it is twice R squared times 1 - R whole squared and. So, the conclusion is that which is always non-negative. So, R c is at least as good as R u in every possible case as long as the elements are identical and independent. This can be generalized of course under various values of number of elements in each subsystem and but the general conclusion is that the component redundancy is better than unit redundancy. And for more details you could read the excellent book by Martin Show.