Structural Reliability
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Lecture –118
Representation of Systems (Part -22)

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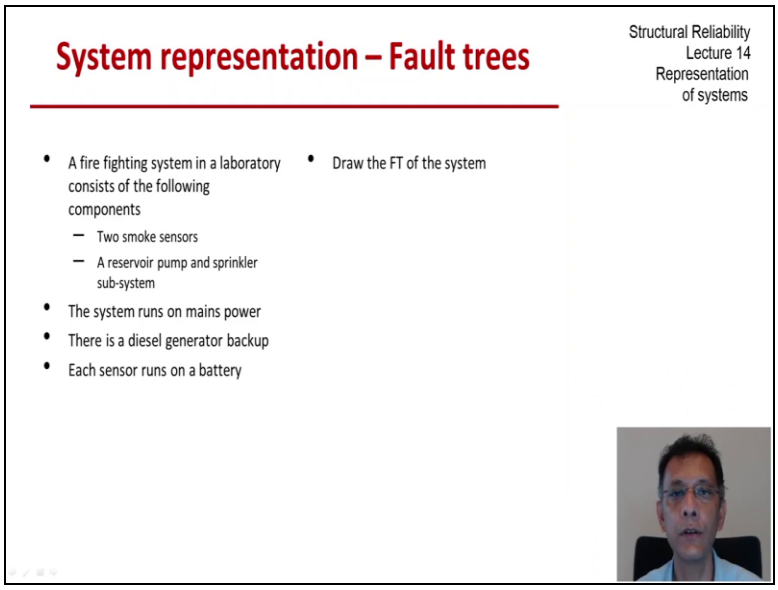

In the last example on fall trees we are going to look at a problem involving a fire fighting system and end with computing reliability of that system. So, here is the system description it consists of two smoke sensors pump and sprinkler subsystem a power supply system that involves mains and a backup and sensors themselves need batteries. So, the sensor system does not depend on the mains of the backup power.

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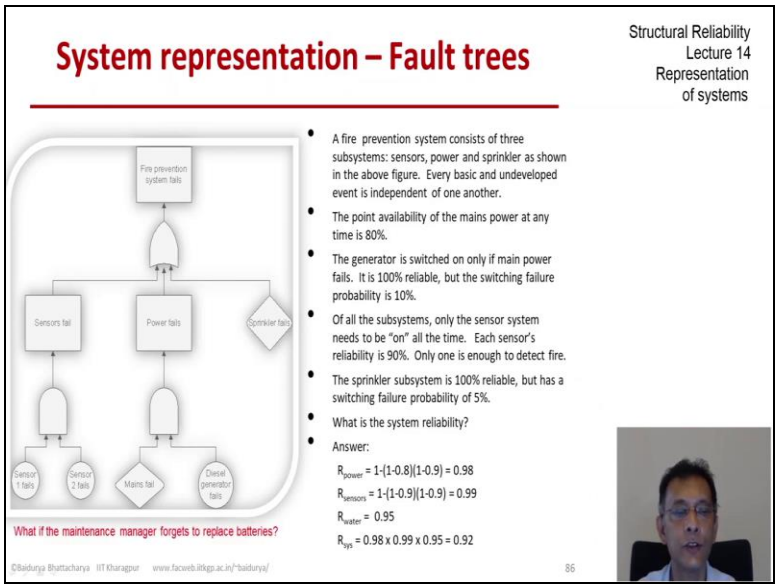

So, the first task is to draw the fault tree of the system and then we will put numbers and compute the reliability which will be a very simple computation. So, our top event is the fire prevention system fails and then that can happen in any one of three ways which are in series. So, either the sensor system fails or the power system fails or the sprinkler water and pump system fails the last one mentioned it is an undeveloped event and the sensor subsystem requires both of them to fail.

So, that is our understanding of this system both sensors have to fail in order for detection to fail. So they go through an AND gate the mains and the backup both have to fail in order for the power system to fail and the sensor failure the diesel generator failure they are all basic events. So, no further development is required and the mains failure is an undeveloped event. So, we do not need to know we do not think we need to know any further detail there.

So let us put some numbers the point availability of the mains is 80% we have not discussed availability really but it basically means that at any given time the system has an 80 chance of being up and then 20 chance of not being up. The generator itself is 100 reliable but there is a slight switch failure issue and that is 10 probabilities. The sensor subsystem needs to be on all the time and each sensor has a reliability of 90%.

We are not talking about the batteries separately at this time. So, and finally the sprinkler

subsystem is fully reliable but again just like the diesel generator it has a switching failure probability of 5%. So, what do we mean by switching failure that when it is asked to come online if the switch does not work properly then it is not able to perform that function. So, the system effectively fails.

So, what is the system reliability it is a straightforward problem we have solved many problems like this already in this course. So, let us do it step by step if you would like to go through this please pause this video otherwise let me present the steps the power system reliability is 98% the first term in the brackets comes from the main power availability the second bracketed term comes from the diesel generators actually its switching failure probability is the only contribution there.

The next one is the sensor system and there are two sensors and they work independently that's the assumption and. So, together the sensor system has 99% reliability. The sprinkler system is 95% reliable the 5% failure probability comes from the switching issue. And then finally putting all of this together would give me and again assuming that all the components are mutually independent the system reliability would come to 92%.

Now here is an interesting thought I want to leave you with is what if the maintenance manager forgets to replace batteries in the sensor. So, presumably batteries are replaced together. So, if one fails the other one is almost certain to fail batteries have run out of their power. So, how are we going to augment default tree and how are we going to incorporate that information if you know the reliability of that in the system reliability numerical computation that would be a thought I would like to leave you with.