Structural Reliability
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Lecture –10
Review of Probability Theory (Part -02)

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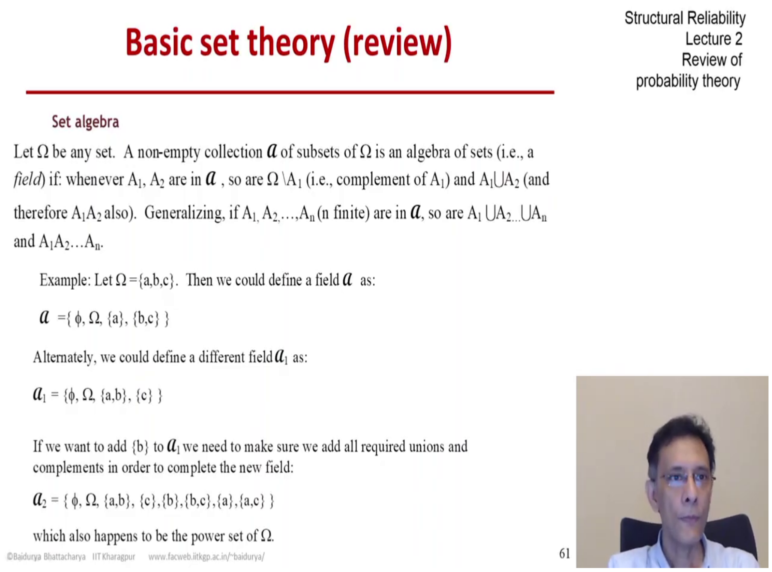

When we want to assign probabilities we need to decide which events are relevant and which we would like to ignore say we want to cast a die a six-face die but we may not be interested in all the 6 outcomes all we might care about are the even faces. So, that is fine then all you need to do in addition to defining the set of even outcomes are the set of odd outcomes. Take another example a coin toss if you are interested in head as an outcome then the tail needs to be automatically defined.

Now if that is all then you have decided that the coin landing on its edge is not an outcome worth considering. So let us say we have the sample space consisting of three elements A, B and C then we could define a field script A which is a collection of subsets of omega as the null set which must always be there and its complement. So, the sample space should also be there and then A and its complement BC. So, these four would constitute a valid algebra of sets from this sample space.

We could also define a different field script A1 and there we could have the null set the sample space and A, B and C. So, these four would also be a valid collection of sets. Now we might want to add the member B the set B to the collection of sets script A1. Now to do that; we must make sure that we add all the required unions and complements in order to complete the new field. So, the moment we add B we need to add the union of B and C.

So, BC has to be there and the moment we have BC its complement A should be there and the moment A is there C was al already there. So, the union of A and C should also be there. So, in the end what we get for this just by wanting to add the single element B to the collection A1 we have ended up with the power set of the sample space. In the next slide let us work through a small example defining the smallest algebra that contains two sets of our interest.

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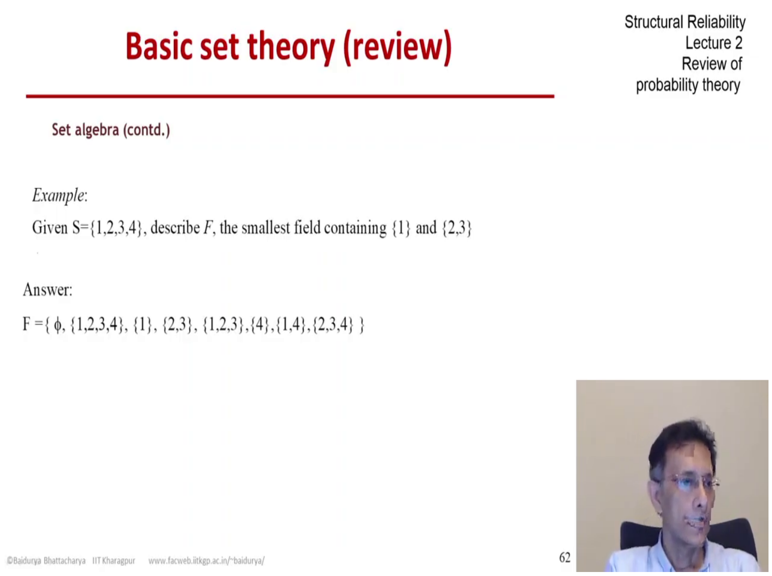

So, given the sample space of 1, 2, 3 and 4 we want to define a field that contain 1 and 2, 3. So, then we have to start with the null set and the universal set and then 1 and 2, 3 are there but because they are there the union must be there then the complement of that union should be there. So, that is how we get 4 and the moment we have 4 then its union with 1 must be there and its union with 2, 3 should be there. So, that would be the smallest field that contained the 2 sets of our interest.

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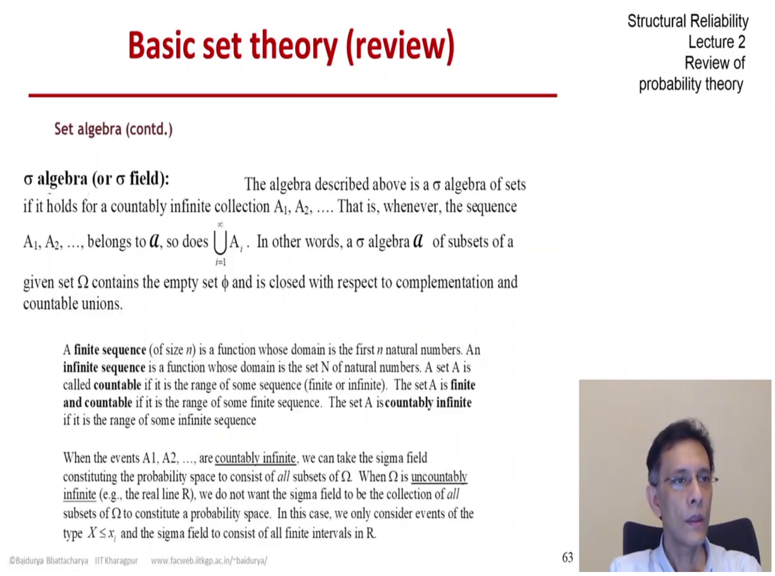

Now when you need to generalize this concept of set algebra to a countably infinite collection that is as we will see to include random variables either continuous type or discrete random variables whose range is say all positive integers. Then we have sigma algebra and define them in the most efficient manner.

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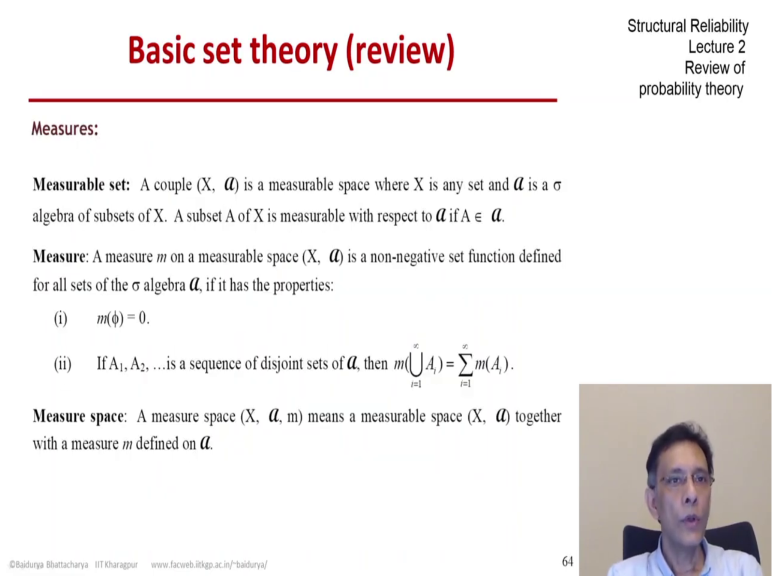

Then we need to define an appropriate measure on the sigma algebra which in our case will be the probability measure.

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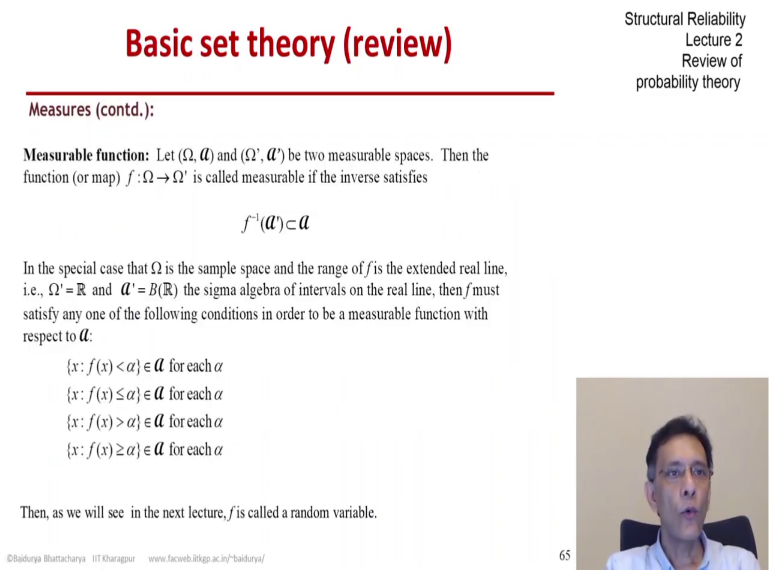

And when the outcomes of the random experiments can be defined in numerical terms that is the sample space can be mapped onto the real line and in particular onto boreal field of intervals on the real line we will call that map the function a random variable.