Symbolic Logic
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Lecture - 06
History of Symbolic Logic

Hello, we have finished the introduction of the elementary, things that we need to learn Symbolic Logic. This module 6 is going to be sort of a historical introduction to what we call Symbolic Logic.

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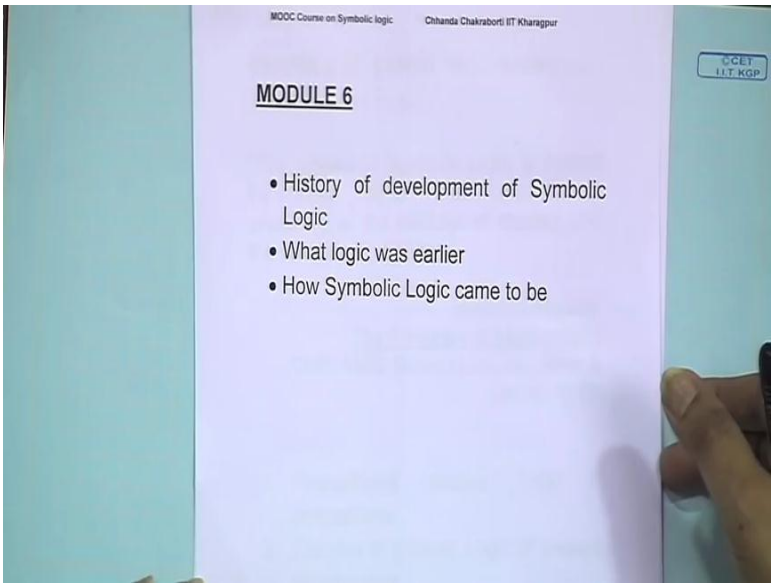

You see it is better to understand what you are learning in a context and every discovery or every invention that you know has a sort of a social and historical context. So that is what I am trying going to initiative to is that not just the symbols of the Symbolic Logic, but how the Symbolic Logic came to be that is what we are going to learn in this module, what logic was earlier and what is the special theory of Symbolic Logic and why Symbolic Logic developed in the way it has. So, this kind of answers you are going to get in this module.

So I will start you with this sort of historical on this historical note, but not before I tell you that Symbolic Logic you can find it also under the name mathematical logic.

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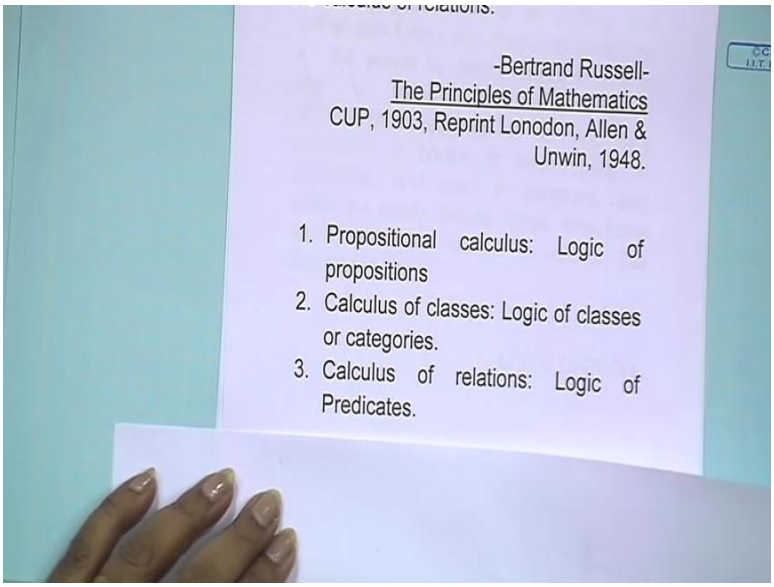

Now today it may not sound like any things strange, but their voice used to be a time and that is what I am going to tell you. When logic was not mathematical, logic was speculative just like you know there use to be a time in physics was not as mathematical as it is today. So, the new physics that you have is a different kind of a understanding on physics, which requires mathematics and without mathematics one cannot even think about, but the earlier physics use to be more theoretical and speculative and on. So, what you are learning is that this is one kind of logic which has clear mathematical character. Now the description of what is the subject of this Symbolic Logic. I have taken this from the very founder of Symbolic Logic namely Bertrand Russell. Many of you may have heard this name also please look him up in the internet and you will find that he is a prolific writer, thinker and he not only writes about logic, but also on many social issues of his time.

So, Bertrand Russell writes in Principles of Mathematics, that the subject of Symbolic Logic is formed by three parts. One is the calculus of propositions. Please watch the term calculus. That is a clear reference to the mathematical character of the kind of logic that

is doing with propositions and then calculus of classes and the calculus of relations. So from this we have gain the name propositional calculus which we are going to soon going to learn, but this tells us that there is going to be three components in this logic. One is as I said propositional calculus or the logic of propositions.

One is calculus of classes will try to tell you what they are these are not exactly sets, but sort of a rough understanding of collections. So these are classes and this logic is known as categorical logic or logic of classes will look into that and then calculus of relations. This is not a relation between human beings, but this is more about predicates n place predicates. So this logic of predicates we are going to have some idea about each of these components as we go along.

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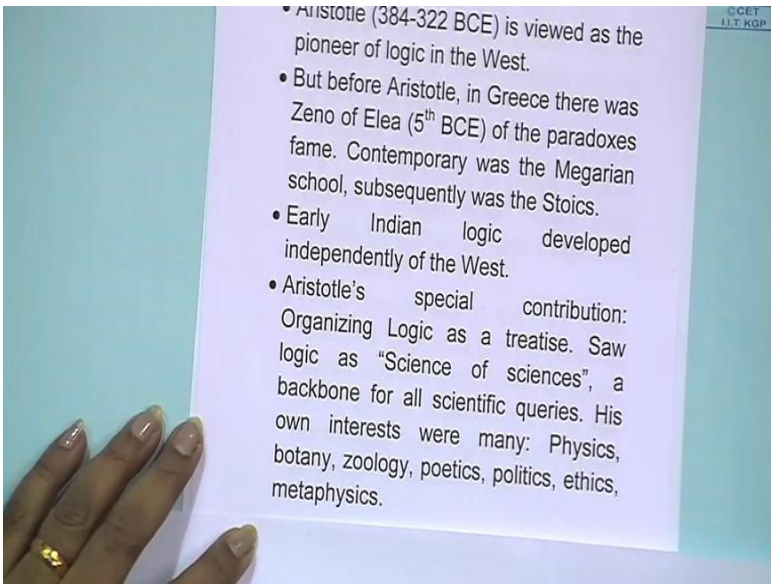

Now the question is this kind of a mathematical logic how did it suddenly come to be. What makes it come through? What was logic like earlier and so on? So, I have named this part of the lecture the evolution of Symbolic Logic. Because you know as thing grows slowly so that is what it is all about. So, first to note that it is a rather recent development, it is a 20th century development and what it sets apart from earlier kind of logics is that it has as I said it has a definite mathematical character in it it is a calculus its sort of an algebra and so on.

Many of you know or may be all of you know that if we talk about western logic, then the person that we look up to as saying that he started it, he is the pioneer; he is the Aristotle and look at his time we are talking about third BCE. Now this is usually the popular notion, but let me bus that meet and say that historically we find that even before Aristotle logic existed in Greek word for example, Zeno belong to fifth BCE. So at least 2 centuries before Aristotle, there was in Greece a logician calls Zeno. Zenos paradoxes by the way are world famous and they still continue to amazes. So please look up Zenos paradoxes, when you are doing next internet search look this up and you will be pleased to find that they are interesting and stimulating. And apart from Zeno we also find some logic schools for example, the Megarian school, for example the Stoics school. They had separate logic system. So in a way the Greek word had logic earlier, but Aristotle has certain contribution; so will talk about that separately.

I will take this operation to remind that, early Indian logic developed independently of the west, along this time. I had shown you earlier that the ancient logical treatise, Indian treatise can be found from 6th BCE on words. Now why do we still look into Aristotle in western logic if there were other logicians to and the contributions are actually amazing. What he did was to organize logic as a treatise. So systematizing logic, teaching it as a subject, bringing principles that is what Aristotle brought into logic.

In fact what we saw logic as is the science of the sciences remember he was one of those persons who dappled in practically all branches of science and other arts for example, he Aristotle's physics is well known, also he had interest in botany zoology and then he also has theories in poetics, politics, ethics metaphysics. So, he had all rounded interest and he was only person, but in logic he saw the back bone concept. So all the discussions in various subjects, x suggest this what would guarantee that the argument is going in the proper direction, in that he thought logic can help us guide into that.

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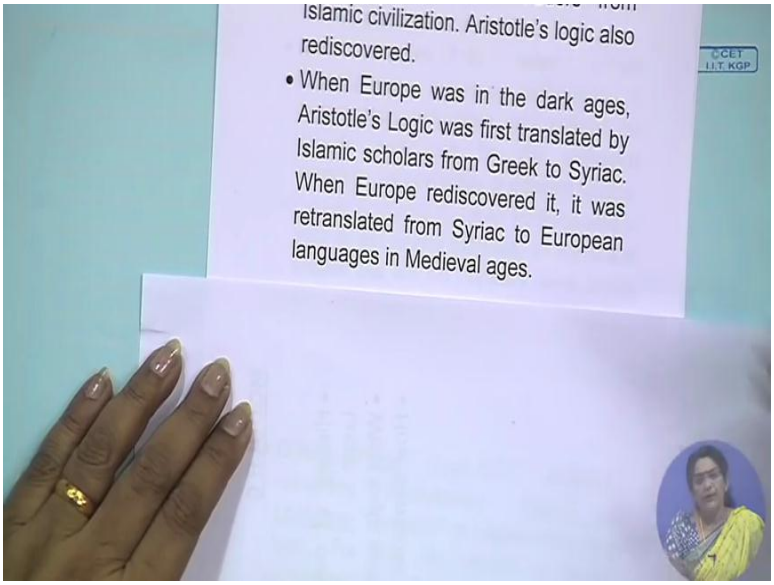

So that was his contribution basically to see the logic as a foundational subject that would provide a structure and the spine, the back bone in this all this discussions. More over what Aristotle did is to bring in what we call the idea forms. See today we talk about formal logic. In formal logic there is a form and the contribution out of this forms the thought that there may be logical forms underlying our discussions that is an Aristotle concept. So that is what you brought in also into logic. Why we could not stop with Aristotle logic. If we have done so much then what is the point of going into modern Symbolic Logic and this is where the history is going to help you to understand that.

See there was a time when all of this whole Greek civilization and what it brought in for example, Aristotle theories and (Refer Time: 08:37) drama, anything that you can think about the Greek civilization was lost. Because you know that Europe went through a crisis period, intellectual crisis period, what we call the Dark ages. So once the Greek civilization went, there came Roman Civilization, there came Vandals and so for and slowly there was dealing between what was the European glorious past and what was the time that they were going to. And this is what is known as the dark ages in Europe.

So for centuries Europe did not even know that they had this wonderful legacy. They did not know anything about the Greeks, what the Greeks have done and the work the

intellectual contributions that they have made. Medieval ages, which is from 5th CE to 15th CE. This is when slowly, eventually the Greeks texts started to come back to Europe. You have to understand that in the medieval period or in the dark ages when Europe was in an intellectual void.

Islamic civilization on the other hand was gaining its peak. So the intellectual contributions of the Greeks somehow was taken or they it found its way to the libraries in the Islamic word. For example, Baghdad the house of wisdom and that is where this takes sort of founder way too. So Aristotle's logic also the texts, sort of went there and eventually as time is the wonderful thing it was brought back to Europe through the Arab traders. You know the more civilization the introduction with Europe and the Islamic word. So one of the falls out of that was the discovery of this ancient text and Aristotle's logic was again rediscovered at this time.

When was lost from Europe's, Aristotle's logic was translated by Islamic scholars into from Greek to Syriac and it was kept in the library and they knew about the Aristotle logic. Now when it came back to Europe and Europe sort of rediscovered and it they were amazed by this discovery it was they can retranslated from Syriac to European languages and this is what happened in the medieval ages.

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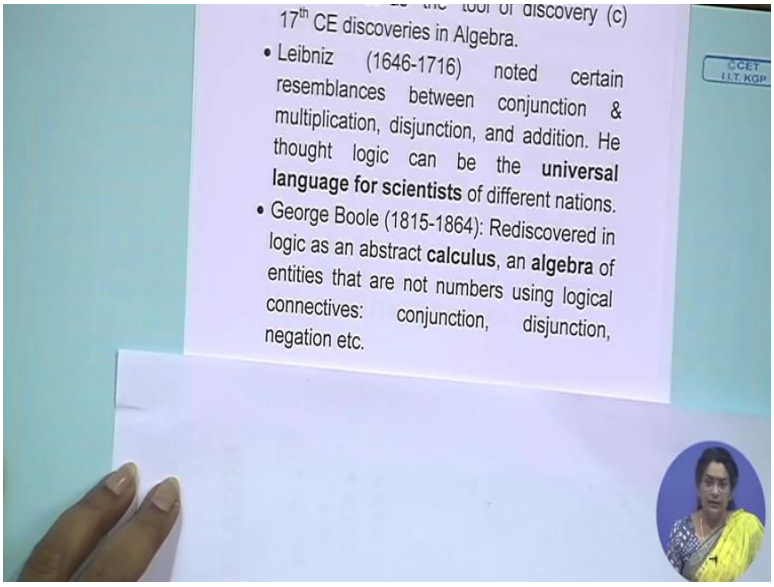

So the medieval ages is some sort of a European with discovery of its past and when that happened, you know what usually is the case that, when we do not know what we have and then we suddenly gain it you are enthrone by it. You are completely taken by it and you are. So impressed that you start to think that it is perfect and that is exactly what happened with Aristotle's logic. Among many other things Aristotle's logic came back to Europe, when that happen the medieval scholars started to work on it to study it and for thousands of years Europe continued to thought that this logic is ultimate, that it cannot be perfected anymore and this where logic should stop. When that happens you know usually a filled dies, when you start thinking the there cannot be any for the progress it usually its starts to declined.

Along with something else happened you know, you probably know that, after the medieval ages came the time of Renaissance. Renaissance those of you have heard this term, you know it is a time of awakening or re awakening. So whatever slumber, whatever sleepy state Europe was in it was coming out of that slumberous state and it was awakening and it brought this Renaissance brought a radical change in the European mind set and they were critical of the past. Everything that was in the past is started to question it and through that kind of questioning, they gained new knowledge and new sciences.

So during this time this Renaissance is the time, when you see that the modern science sort of came about through the critical inquiry of the past. Regarding Aristotle's logic, we find that. During Renaissance time there where at least three kinds of critiques of this, for example, humanists said that you know we do not find any literally value in Aristotle's logic it is not good enough and then Galileo brought in the new physics of a rotating glow with telescope and all. So there was new interest. So why would we look into Aristotle's physics anymore, because it is clearly a new physics is on the rise. Similarly therefore Aristotle's logic is also of no use. Then there was also the discovery of the algebra. You know that the contribution of algebra rise from algebra from this Islamic scholars. So there was interest in the algebra. For all this reasons Aristotle's logic slowly found in the back burner.

So people where becoming these interested in logic. When this is happening and when the new algebra is coming in there is a new way to think about mathematics this is about the time in 17th century, people started to see similarities between mathematics and logic. For example, Leibniz, I am sure you have heard the name as one of the founders' calculus. He started to see some similarities between the way conjunction works and multiplication works. The way disjunctions works and addition works and. In fact, he thought that logic can be the universal language for all the scientists. Because you know not every scientist speak the same language in those times people did not use English as the link language, but he thought logic could be that universal language.

And then came Boole, George Boole many of you have heard this name. If you have done any Boolean algebra, I am sure you know this name by now look at his time and Boole thought that this is the calculus. In fact, that is how the Boolean algebra came to be. Please note that this algebra is not with numbers rather with logical entities and he used this connectives, conjunction, disjunction, negation etcetera to have algebra like formula in logic. So in a way a new vista was opening for logic. Where there was lot of closeness, with the way mathematics is done, with the way algebra is done, with the way calculus was being done.

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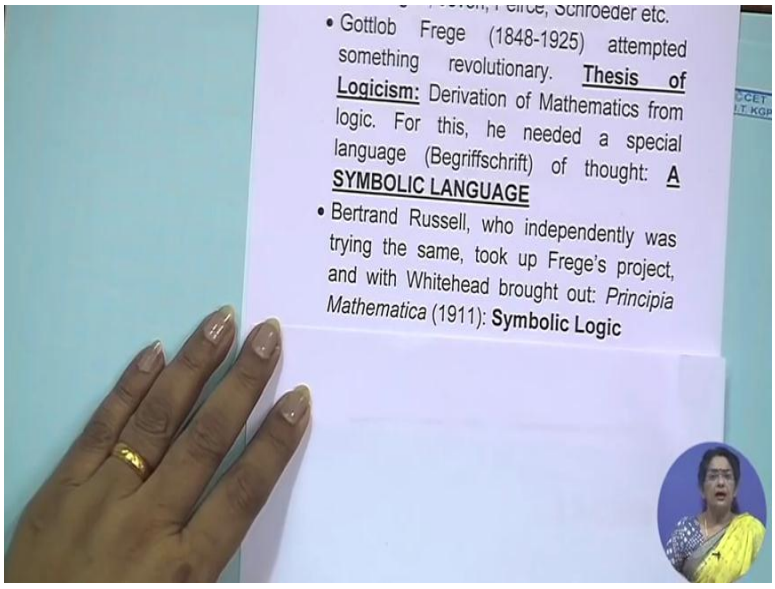

After Boolean algebra was done, then lot a people thought that this is a direction that can be taken. So we soon found that many of the mathematician and logicians they sort of join the hands, to develop a mathematically inclined logic and this is where we get to see that logic started to slowly depart from the Aristotle and paradigm and started to go towards mathematics. Then who are the people who join hence one of them is J Venn of the Venn diagrams. So he was an ardent admirer, I mean he was the fans sort of a Boole he proposed the diagrams of overlapping regions to actually depict the relations between classes, will try to show you that. But this Venn diagrams was one and important contribution towards this mathematization of this logic.

Similarly, there was Lewis Carroll. Again whether you have read his words Lewis Carroll's I do not know, but Alison wonderland he is the author of that, but he was also an excellent mathematician and he also join hands to come through to contribute towards this goal to mathematics logic. Then there were many others for example, De Morgan, you till that learn about De Morgan's theorem.

So De Morgan, Jevons, Peirce, Schroeder all of them sort of came in. So it was a movement that sort of (Refer Time: 17:07) but the radical thing was by this logician call Gottlob Frege. He was trying something very radical, what he was trying is known as the thesis of Logicism. What was he trying? See the others were trying to bring logic closer to mathematic, they what finding resemblance between logic and mathematics, but what Frege was trying is to derive mathematics out of some logical actions. Extremely ambitious project, but he is thought he can do it.

So but for this he needed a separate language, he decided that you cannot work with ordinary language, the writing language of the scholars. So he needed a symbolic language and this is where we need to pause and note because the symbolic language will soon become the part of this mathematical logic. You will soon see when we start doing the syntax of Symbolic Logic, that it is a completely symbol best language.

So this artificial language concept, that today you use in computer programming and so on. Actually is from this kind of ideas that we need a special language to express special thoughts. Gottlob Frege as I said was trying this logicism idea. So was Bertand Russell,

but independently. For a long time they did not know about each other's work, but then Russell discovered because the Frege was writing in German and it was rather difficult writing. So lot of people he did not have a lot of wide audience, but Russell found it out. And Russell read it and soon he took up Freges project, that is it there is a story in here, which I do not have time to recount, but you can look it up, but Russell took up Freges project.

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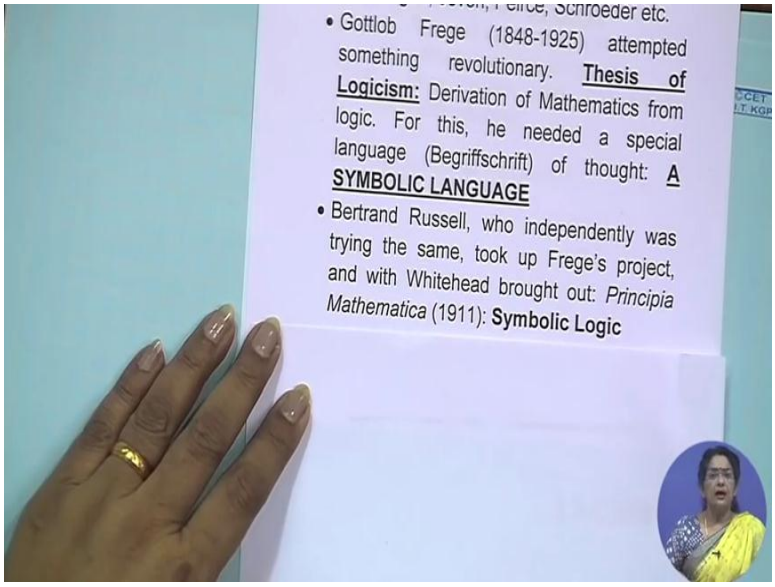

And then finally, with his mathematician friend whitehead brought out the principia or principia mathematic which is where we find today's Symbolic Logic. So you see this is how we have this mathematical logic, which is basically a system developed by Russell and whitehead, so we call it the Russell Whitehead system and then it is as I told you its logic but with mathematical inclination. It contains three kinds of calculi, calculi is the plural of calculus. So it has distinctly three calculi. Propositional calculus, Class calculus and Predicate calculus and then as I also point it out that it requires an artificial a specially created language, to express the tautologies of the system. So there is the very symbolic nature of this logic and there is also claim that is sort of a language.

The idea is to avoid the imprecision that exists, the vagueness that exists in ordinary language, that is why this use of this special language. But it also keeps on using English

words as you will see, but then assigns it technical meaning. So in a way what we have learn today is about this Russell whitehead system, How it came to be, in what way is it different from the earlier Aristotle logic and what where the reasons why people found that it has to be a mathematical kind of a logic and I have through this history I have try to introduce you to Symbolic Logic.

And from next module we are going to actually start learning the Symbolic Logic this is all for this module.

Thank you.