Environmental Geomechanics
Prof. D. N. Singh
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Lecture – 03
Overview

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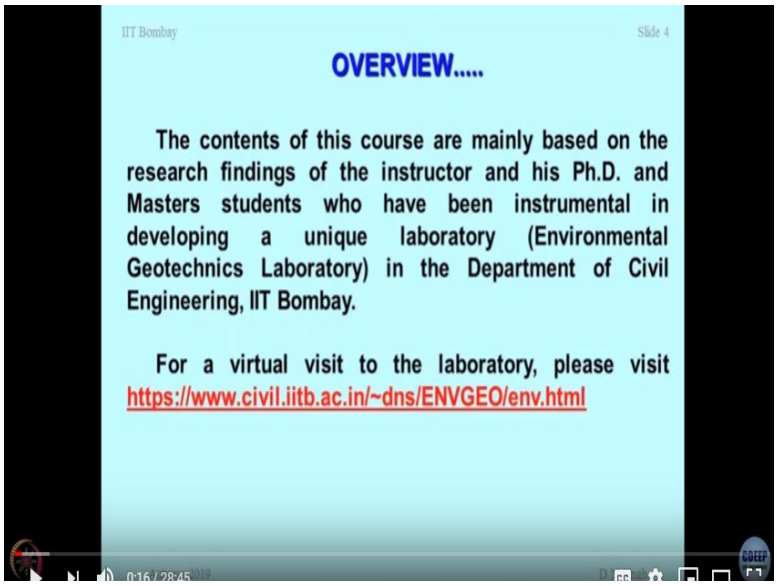

This was the overview of you know what the environmental geomechanics would be what is your reaction to this.

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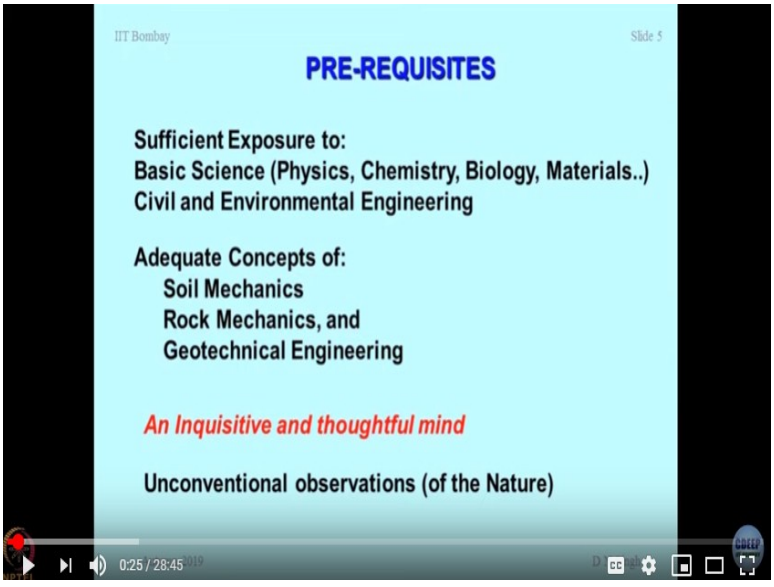

“Professor - student conversation starts” Rashmi you have not spoken what comes to your mind after seeing all this background I am pretty excited like as an engineer I just want to give something to society. So this is a real-life problem and will be learning like this. Yes please, when you are dealing with radionuclides I specifically want to ask like whenever you set a nuclear power plant, they already have a unit that deals with waste and there are very stringent rules like regarding how to keep it and how to transport it.

So why are you getting into this thing because there are already the nuclear plants operating in the India and all over world and they have specifically for each plant they have unit to control the waste and all these things. Try to find out this answer yourself from the net and number two is that when I started my career these people came to me to help them. So that means it is understood that they do not have any answer to their questions.

So, in the process I started guiding I guided 3 PhD students from atomic energy employees and the very first one was in the almost year 2002-2003. So I am sure you must be realizing that in 2000 plus also India was not having answers to the questions that how the waste should be disposed and how it should be buried and what should be done with it because you are slightly missing up your own question.

Radio physicists and the atomic faces do the experiments in the reactors yeah by the time experiment is over they take off their gloves and they throw it in the dustbin, and they walk out of the place. Now the question is where this waste is going to be disposed and how? So, the story starts from there number 2 whatever the waste is being dumped or generated in a big manner from the fuel cycle how will you take care of that?

So these are the questions which still people do not have the answers for. So, we will talk about all these issues and then how all these concepts are assimilated in the environment of geomechanics this you might appreciate okay. “**Professor - student conversation ends”.** So let me talk about the prerequisite for the course prerequisite I hope you understand the world what is required from your side so that there is a synchronization between our thoughts yeah.

So I was also like you know until a few years back and then I realize that if you have to survive in today's world as a professional these are the two main subjects which we have very conveniently ignored as engineers so-called so I am sure those of you who are inclined towards R and D or those of you who are going to deal with the problems which are prevailing the society you cannot solve any problem keeping biology chemistry in abeyance why? You will realize this very soon.

Because most of the issues which we are dealing with they are heavily related with the bioprocesses why do we age clear it is a biological activity and when you age what happens with biochemistry changes okay, we will discuss about this. So sufficient exposure of the basic science is a must in today's technology, and this is what we have very conveniently ignored until now all of us you agree or not our teaching has been you know mug up X and Y and Z and that is it equations.

The situation is like this that there are no equations to help you because you do not know the parameters. Even if you know the parameters you do not know how to estimate the parameter. how to determine the parameters of how do you put them into an equation to get the answer. So everything is not known clear we deal with a lot of situations like this. So physics concepts are required you are talking about the atomic physics what type of radionuclide is coming.

Chemistry, radiochemistry, biology what type of flora fauna is existing in the subsurface agreed. So very hot topic for environmental geotechnical refreshing of pathogens in porous media migration of you knows radionuclides in porous media, the fate of nucleates in porous media. From sewage treatment plants whatever effluents are coming, they must be having a lot of pathogens sediments have lots of pathogens.

So how do these pathogens migrate from one place to another place subsurface how microbial activity changes from one place to another place over a period of time. All right are you realizing this or not and then comes the materials different type of materials which requires an approach of material scientist you have mastered concrete you have mastered steel your mastered glass you have mastered plastics have you mastered soils.

Very soon you will realize that you have talked about only one attribute of the soil which is mostly physical attributes your particle size, specific gravity, compressibility which are engineering properties. But truly speaking all of them are related to the physics of the material. So 90% of the gamut of the activity has still not been fathomed has not been explored and unless I explore that I cannot give the right answers to the problems is this okay.

So basically you require a lot of exposure to civil and environmental engineering which all of you are having adequate concepts of soil mechanics rock mechanics geotechnical engineering what is the difference between rock mechanics, soil mechanics and geotechnical engineering why I have written it separately any idea? **"Professor - student conversation starts"** various forces and various forces and acting on the surface okay rocks.

So what is the difference between 1,2 and 3 there is no difference you see how to understand all these things you know why, why is important to understand the difference between one two and three yes sir actually in soil mechanics we generally deal with the behaviour of soil, okay and in rock mechanics I think we deal with the tunnel we can. A tunnel is an object how to the behaviour of big boulders or how to deal with the behaviour okay good you are quite close yeah next and geotechnical engineering?

Geotechnical engineering with the type of technologies how to deal with the soil maybe I am not sure broader term yes please give to him a very nice application. Application of what? soil mechanics very good so soil and rock mechanics are the mechanics of the materials and when it comes to the application geotechnical engineering have you understood now the difference between how the material behaves is what you have studied.

Now you have joined in the geotechnical engineering division of IIT, Bombay you should have questioned this why geotechnical engineering why not soil mechanics, rock mechanics region clear. So geotechnical engineering is mostly application-oriented so whatever you are studied until now in terms of the material and its behaviour now I am going to use it for different applications.

One of the applications could be making a tunnel another application would be making a tunnel in the sub-zero climatic conditions. Another application would be making a tunnel beneath the sea you know how many situations I have created the eternal remains same the material remains the same or might be different, but the circumstances have got changed agreed.

So, when you deal with the geotechnical engineering is a very larger or the wider as spectrum what he is talking about is correct. Where you are talking about the applications of the material and its response clear in terms of creation of something is this fine now this is very important for this course what I have written what is the meaning of this not in the literal sense Rashmi what comes to your mind and inquisitive and thoughtful mine.

Knowledge of whatever we have studied and we should be ready to think beyond that yes very good anyone else Srikanth what do you understand by an inquisitive and thoughtful mind maybe like you should not accept everything that taught you should enquire in everything like what is what, what is what good okay.

General awareness of what is happening in our surroundings we should be very we should live in present okay we should watch everything around us. That is a thoughtful mind and inquisitiveness question you are right to question everywhere. So this is a prerequisite for this course or this discussion you know you should have a lot of questions in your mind why something is being said whether I should follow it or not I would have to confront it I do not agree with this I have another logic.

So, create parallels between what is being said what is being told what is being discussed and maybe your own ideas. So then you create a situation another situation as I said this discussion is mostly situation oriented you know take a simple case or tunnel, I created different situations. So when you are doing something beneath the sea it is a different situation whatever precautions will be taking through tunnels can you blast.

What you could have done in the mountainous regions where you could have done blasting control blasting if you do let us say in a tunnel which is underneath the sea and if you do the

blasting was going to happen yeah you are right to correct. So look at the situation there is nothing as X+Y=Z you have to understand X operator plus Y operator and operator equal to and Z will create this type of situation several this is also very important what I have written here.

Vikas yes what is the meaning of this with that inquisitive and thoughtful mind we have to see nature speak loudly nobody can hear. With that inquisitive mind, we have to see the nature unconventionally okay but what others how others are seeing, how I am seeing okay it will be different it will be a different perspective very good here the perspectives matter a lot all right.

So those of you might be aware of the legal system we call them as the criminal proceeding CRPCs you know in the court of law both the advocates have read the same book you agree but the logics are different. So what logics do to the code of conduct this is something related to unconventional observations. So what are unconventional observations which 99.99% of people might have ignored they could not observe them why whether they are myopic what happened what went wrong?

So actually what happened they most of the things they listened up and believe that they are not to self-analyzing the things okay maybe. So bad in self-analysis may be the things may be different that is an interesting analysis of statement yes nice. The things which are which is in actual behaviour is not in that manner that we see so we can think beyond that, okay the thinking must be important in this case.

Yeah so, I mean I do not know how to explain it further like unconventional observation so what appears what the thing generally appears is not that true yeah. So we cannot think beyond that so good. So why this is required for studying environmental geomechanics I think 2,3 minutes back somebody said perspectives yes sir perspective is important clear what are perspectives these are also unconventional observations or observing a fact in a different way, so this is okay I think I gave you enough ideas.

Yes that this is the thing which proves that we are different from others. So this subject is mostly you know situation depending on a number 1 number 2 more of the logic dependent why you

will realize soon "**Professor - student conversation ends"**. There are industrial activities are going to be detrimental to the society what is going to happen the way of looking at things is going to be changed by different people.

So I am running my industry I am producing the products and I am producing enough byproducts which are polluting the environment and the geoenvironment and disturbing the neighbours. I am very happy with the scenario but suppose if I am sitting in the neighbour's area for me what is happening is not a very rosy situation. So this is one of the ways of realizing how the perspectives might get changed from one side to another side of the fence.

As long as I was within these fences, I was producing something but if I am on the other side of the fence I am producing and discharging most of the pollutants. The context has changed so some of the references which I have listed over here the first thing is that I would say that your interaction in the class should be as good as possible. Because it will be difficult for you to you know refer to a lot of books and all.

So the best thing is the lecture notes and the interaction which we are having in the classroom that we should make more perfect all right try to make it a habit of doing net surfing. Also, you should start checking you know various international conferences, proceedings and symposia which are happening. International journals I do not know how many journals you have really gone through until now there are ASCE journals, Canadian geotechnical journal ASTM is there, there are so many you know.

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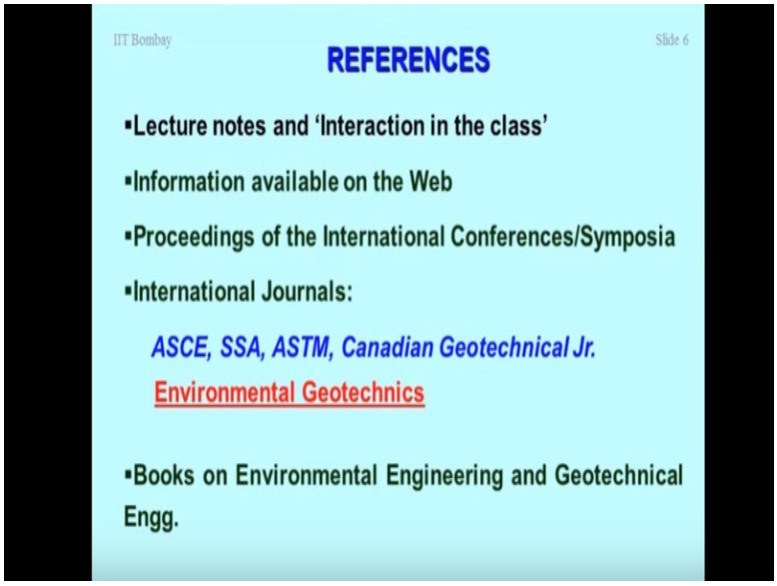

Soil science society of America and incidentally I launched this journal about 6,7 years back environmental geotechnics I do not know how many of you are really aware of this or not it is an international journal which is published by ICE of UK. Are you aware of ICE of UK Institution of civil engineers of UK. So they are the publisher of this journal go through the editorial which I wrote long back.

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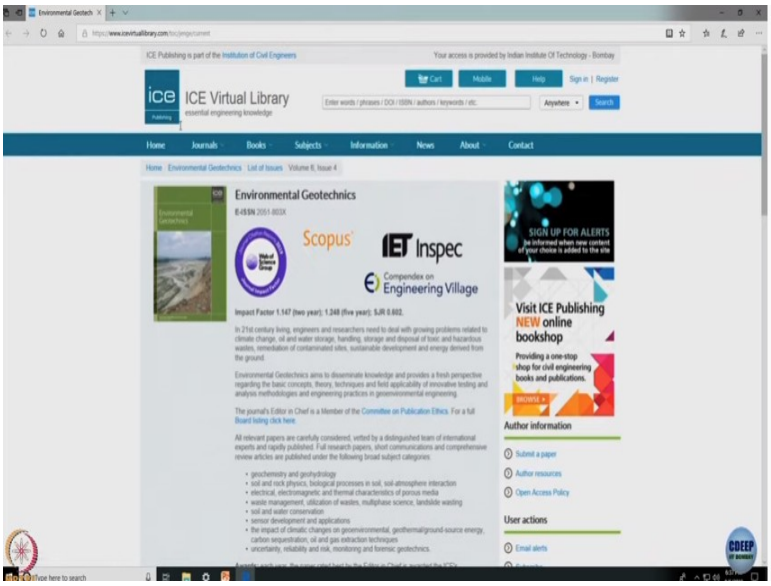

All right so if you check the editor, the editorial board of this journal this is ICE we call it as ice is the cousin brother of ASCE American Society of Civil Engineers or ASTM American Society of testing materials.

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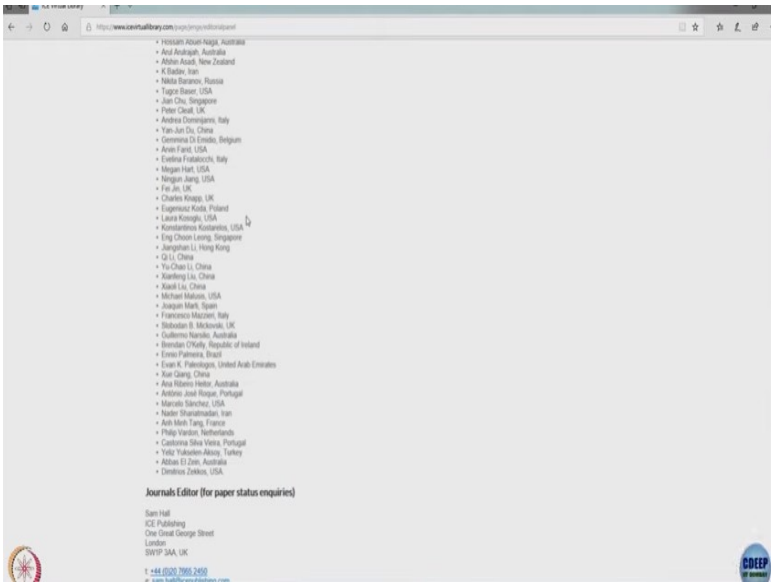

And if you check the editorial board you will get a complete list of this is myself. So I am the editor-in-chief I started this journal about 6,7 years back and I have several advisors and an editorial board member is a very big team and these are the guys who are the frontrunners in the subject internationally all right.

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Editorial

Devendra Narain Singh FNAE, FASCE
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Welcome to *Environmental Geotechnics*, a new international, cross-disciplinary, and fast-track publication vehicle for high-quality research designed to build, showcase and nurture multidisciplinary research in the arena of geoenvironmental engineering. In this editorial I wish to outline the reasons for this endeavor and our vision for the journal's future.

Over the past few decades, a combination of geotechnical engineering and environmental engineering has evolved as a multidisciplinary subject, commonly known as geoenvironmental engineering, which deals with a wide range of geo-hydro-chemico-mechanical issues. To date, there are no journals of repute that either provide a dedicated platform covering this field or entirely emphasize this recent development and hence potential journal contents are spread across a wide number of journals. Furthermore, this subject has matured enough and demands a separate stage for its show. I feel happy to present to you *Environmental Geotechnics* which will focus on various issues related to geoenvironmental engineering. It will also provide a unique venue for sharing multidisciplinary research related to geoenvironment amongst undergraduate and graduate students, researchers in academia and professional practice consultants, contractors and government agencies.

it is expected to flourish in the near future as new ideas emerge and solutions are innovatively modified.

There is a need for an effective, concise, and focused platform to appraise these developments through publication of scientific research and case histories. *Environmental Geotechnics* is required not only to highlight the current developments but also to project the need and direction for further research in this subject. This journal will provide a vehicle for presenting advances and best practices in this area and aims to disseminate knowledge and to provide a fresh perspective regarding the basic concepts, theory, techniques and field applicability (in terms of long term sustainability and environmental impacts) of innovative testing and analysis methodologies, and engineering practices in the field of geoenvironmental engineering.

So what you should be doing is whenever you get time please read the editorial which I wrote and that would be in volume 1 issue 1. So if you click over here you would get this editorial which I wrote all right this will give you a fair idea about what is happening in the world okay

and this would be a good starting point for the subject all right. Another thing is to make it a habit to read the editorials which I invite different professionals all over the world for every issue of the journal. So like if you see volume one, I had written.

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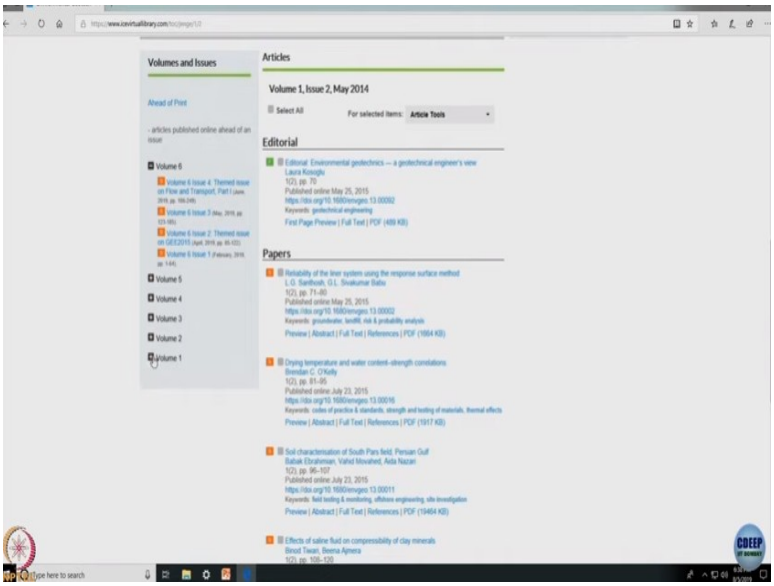

If you go to volume 1 issue 2 you will find you know editorial by Laura Kosoglu. These are the leaders as I said a geotechnical engineer's perspective. So these editorials are available online you can easily go through them and they are not very big they have only 1-page write-ups.

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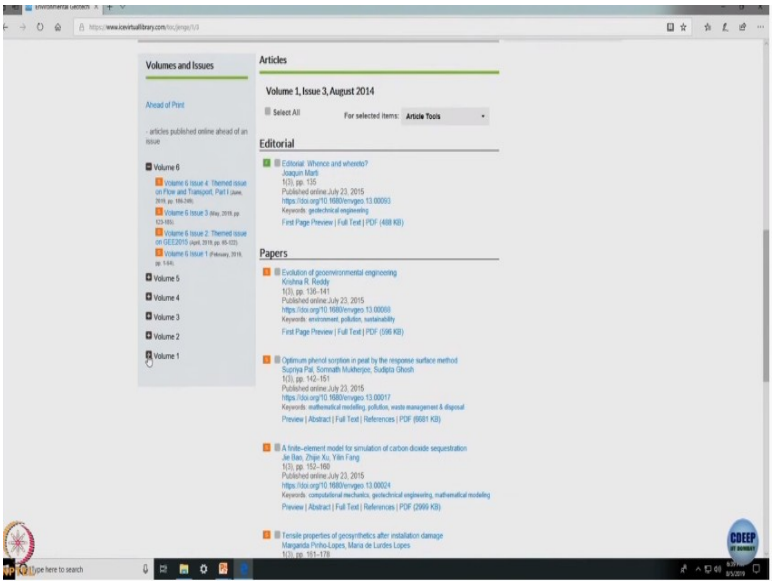

Whence and where to of the environmental geo techniques all right a very interesting titles I am sure you will love to go through them if you see the importance of the environmental geo techniques by Arul Arulrajah from Australia and so on so each volume and issue, I appoint one of the leading professionals in the world to write about what is happening all right.

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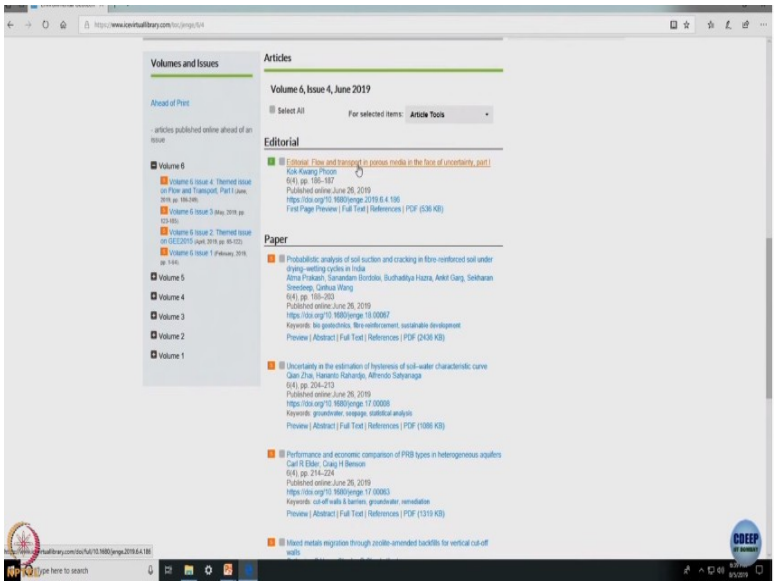

So this is just to give you an idea about what is happening all right. So like a themed issue on flow and fundamental transport, I do not know how many of you know K.K. Phoon he is Singapore and he has written the editorial on flow and transport in porous media in the face of uncertainty we publish 7 papers only per issue all right. You can also refer to some of the books on environmental engineering and geotechnical engineering which might help you.

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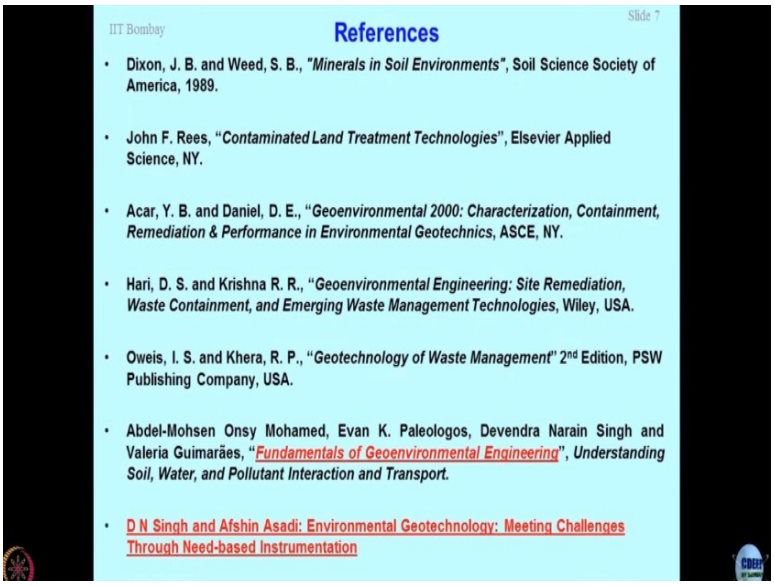

This is just for your reference see minerals play a very important role in environmental geomechanics. So most of the discussion would be revolving around the minerals and the mineralogy clear and because mineralogy is guided by the chemistry of the material. So we will enter into the chemistry and ultimately the mineral is in a physical state. So we talk about the physical attributes of the minerals also.

So we talk about physical and chemical attributes which are dictating the mineralogical attributes of the material or the minerals. So this is a special series on minerals in soil environments we look at the title of the book minerals in soil environments very tricky is it not we should read this sometimes it is not a very straightforward title you are finding something interesting or something very non-interesting.

This is from soil science society of America there is another book by contaminated John reefs contaminant land treatment technologies but these are all specialized books were as I said we do not venture to buy these books just whenever you become an expert in the subject or you want to do practice of environmental geomechanics at that time these books will be very useful for you.

There is another interesting conference geoenvironmental which was held in 2000 characterization containment remediation and performance in environmental geotechnics by Acar and Daniel and there is a book by Hari and Krishna this is geoenvironmental engineering

site remediation waste containment and emerging waste management technologies. There is another interesting book on Geotechnology of waste management, but this is very specialized in the waste management this one and the previous one Oweis and Khera.

There was a book which I was a co-author for you know fundamentals of geoenvironmental engineering but most of the part has been written by my co-authors Abdel Mohsen and Evan Paleologos and Valeria Guimaraes. So these are the guys who have worked in this area understanding soil water and pollutant interaction and transport. There is another interesting book we said writings as long, but it is not complete yet and so this is me and Afshin Asadi we are writing a book on environmental geotechnology meeting challenges through need-based instrumentation.

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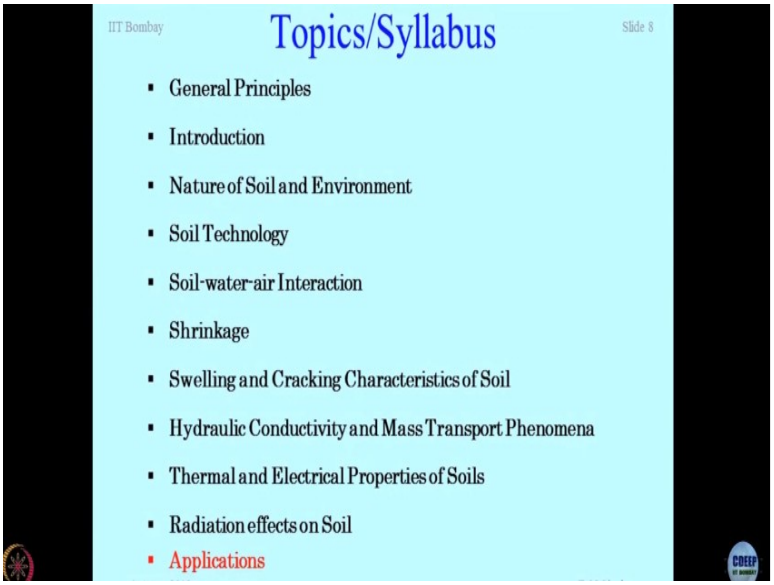

A little bit on the topics and syllabus I will be talking about the general principles of the subject production, nature of soil and environment. Have you heard about nature of soil ever I think nobody talked about nature of file as such but for us, nature of soil is very important like human beings you know they say is a very good-natured person is it not similarly we have to say here soils are having good nature affinity liking, disliking orders, disorders emotions, no emotions and so on we will discuss all these things and the environment.

We will talk about the soil technology normally people talk about soil engineering So you have to understand difference between the engineering and technology also what is the difference between engineering and technology we will be talking about you know how the soil as a material can be used to create some techniques out of it or how to create techniques which can be implied for betterment of the society.

Now from this point onwards well start discussing the soil water interaction which you were talking about a three-phase system, but you are not very close to the interaction term. So even if the three phases are present how these three phases are interacting with each other is a big question because once you start understanding the interaction between the three phases then the geomechanics part gets clubbed to the environmental issues.

We will talk about the shrinkage phenomena until now shrinkage has been supposed to be a curse in the subject clear but now, we will see that shrink it cannot occur it could be a boon also what other we will talk about swelling and cracking characteristics of soils okay. So the deviation starts from the conventional geomechanics well you thought that if a soil mass shrinks or cracks it is a curse it is not so.

There are many industries there are many situations where this property becomes a boon, we will go into the details of that and one of the applications of these properties would be what we were talking about how to handle the high toxic highly you know at elevated temperatures and hazardous wastes which could be. We will talk about the hydraulic conductivity and mass transport phenomena.

So hydraulic conductivity we have already done mass transport you might not have done we will discuss this for it from this point onwards well be talking about the thermal and electrical properties of soils that means when soils and geomaterials get exposed to electric field how do they behave. There are ample situation where this might happen and this concept how it will be utilized for in today's technology clear for detection of something or for creating something and so on.

Then we will talk about the radiation effects on soils how the radiation is influencing the properties of the soils. So, in short, this is what the focus of my discussion would be it might not be in a very structured manner, but I will try to cover up all topics you know either randomly or one-by-one or in the form of a story is it okay. But the broad outlook of the entire course would be of this type and of course, we'll be talking about the applications. So where all these situations are being handled in what way and that forms the application's part is this part okay