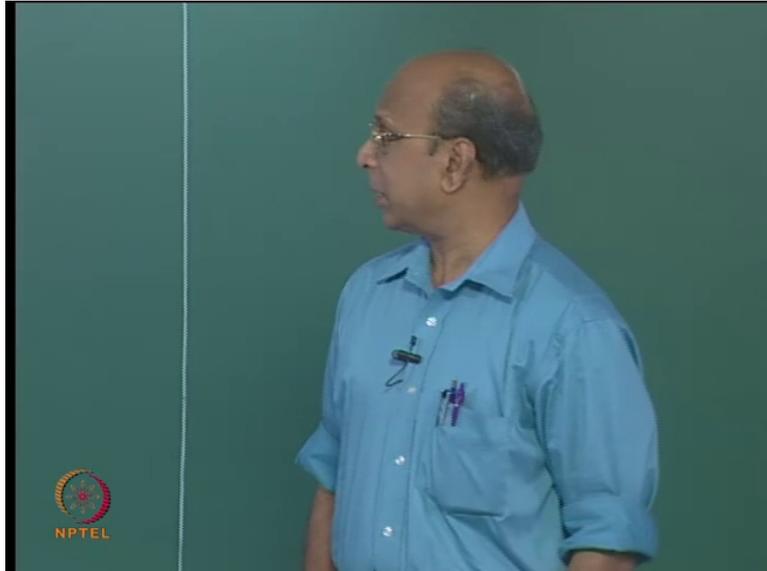


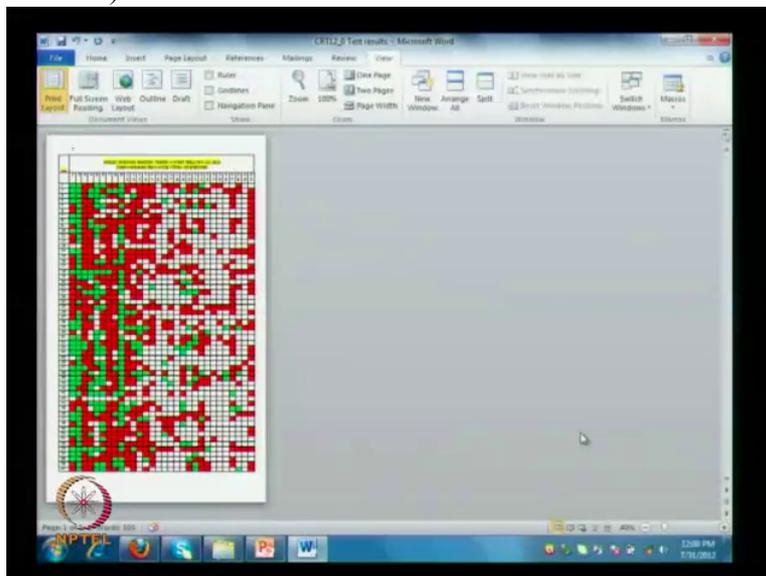
Chemical Reaction Engineering 1 (Homogenous Reactors)
Professor R. Krishnaiah
Department of Chemical Engineering
Indian Institute of Technology Madras
Lecture No 01
Motivation and Introduction Part 1

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They were the results of yesterday's tests and of course as you already know, green is the one

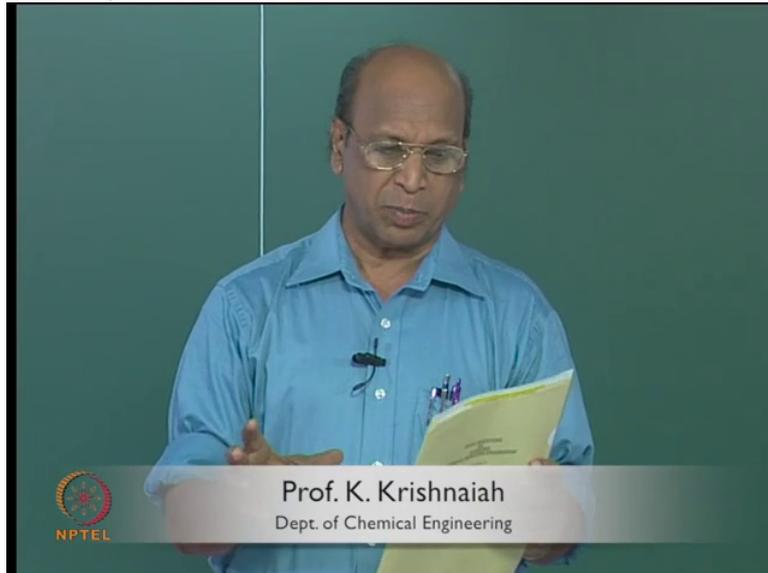
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which you have written correctly. And red attempted but wrong, right? You can see that lots of red patch is there. And you have that white one not attempted.

Ok, so I have also just collected statistics, Ok, that green entire class

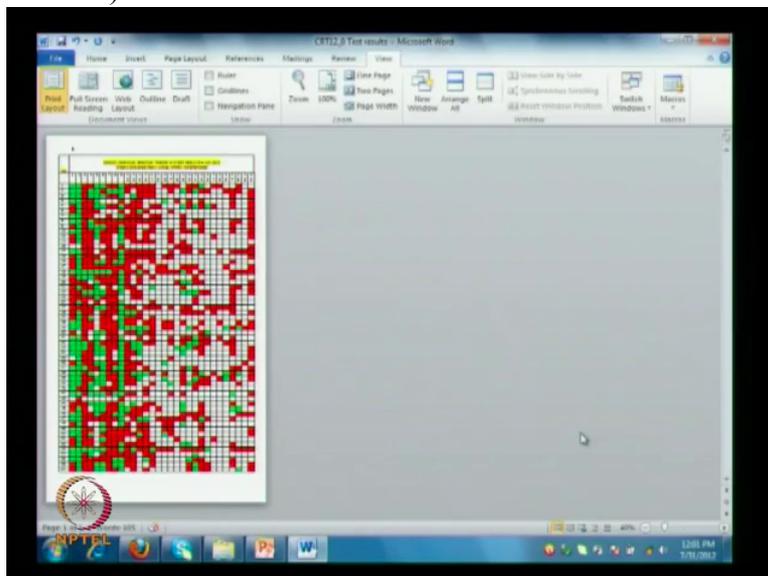
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attempted, only 16 point 7 percent of the questions, all the class together, Ok. And red is 37 percent. And un-attempted, white is 46 percent. And most of you had 2 C R E courses, right.

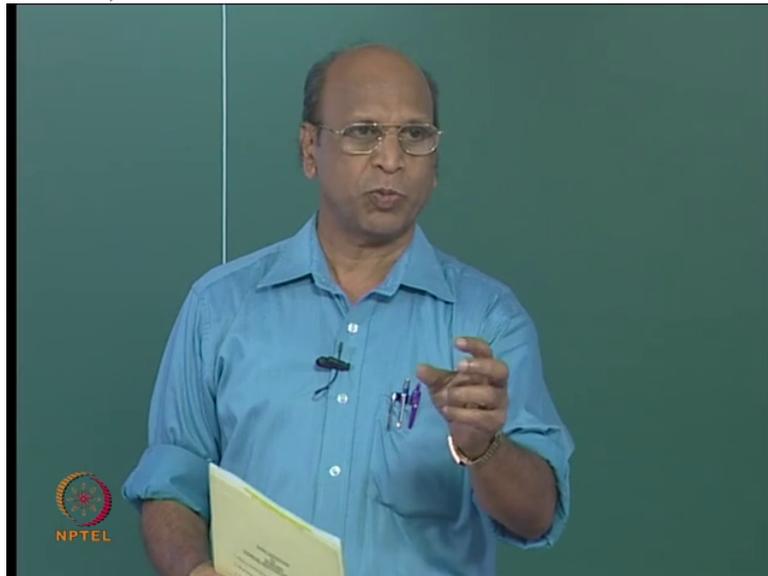
And you can see

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the first few said, on your left side, you have, most of them are filled up either red or green that is Ok but those are the very basic things. That means that is first one or two chapters of Levenspiel book

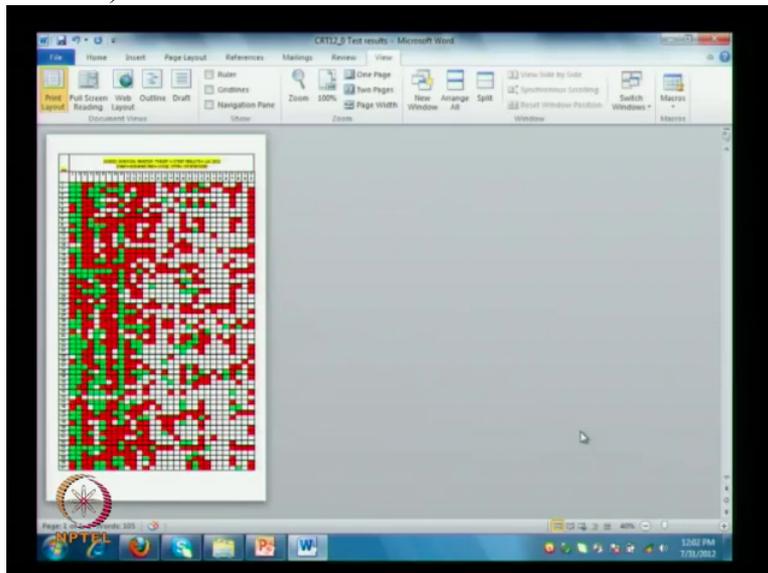
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if you have used Levenspiel book, right.

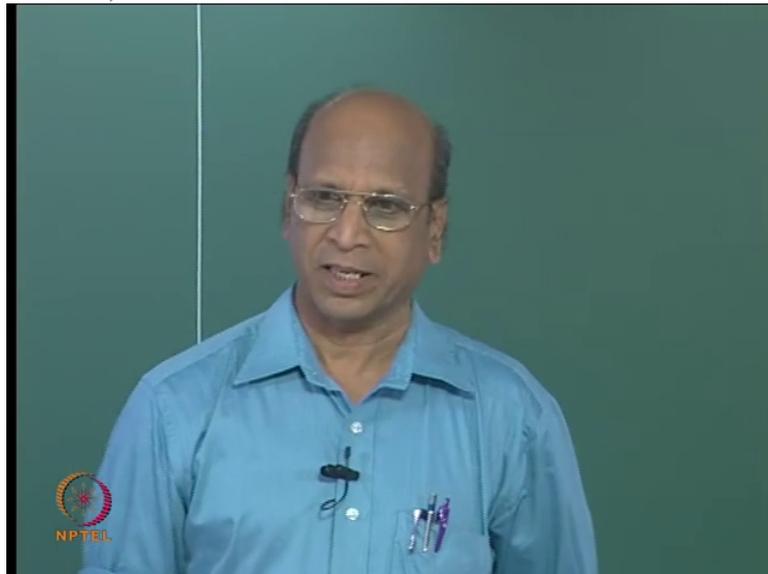
And you can see

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that line, may be second row, Ok, second row is the one which is maximum answered and also the fifth row, that is fifth row, yeah, this one, this one and this 1 and 2 of course, Ok. And you know question number 1, what is you know, chemical reaction engineering?

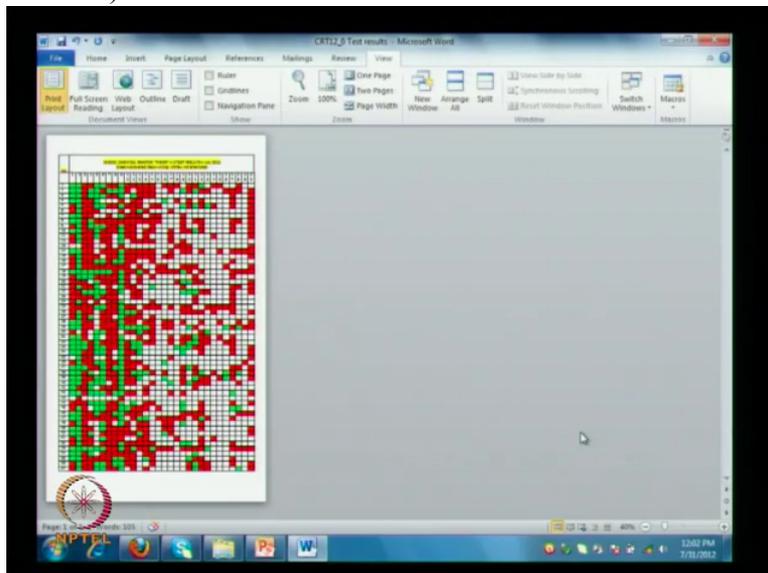
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Question number 2 many people answered what is a reactor. But even then they do not know what is a reactor after taking 2 courses.

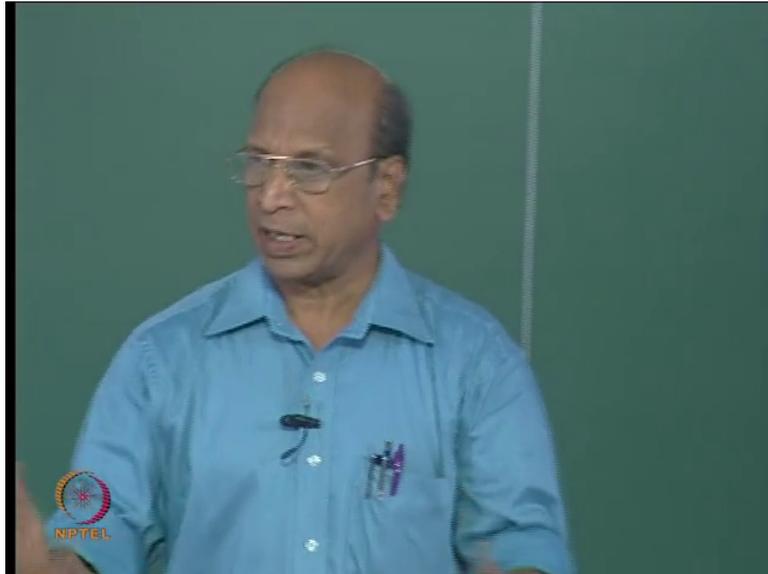
You can see no, some red lines there. Right here, question number 2 is this.

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This, this, this, there are still some, few people who do not know what is a reactor after taking

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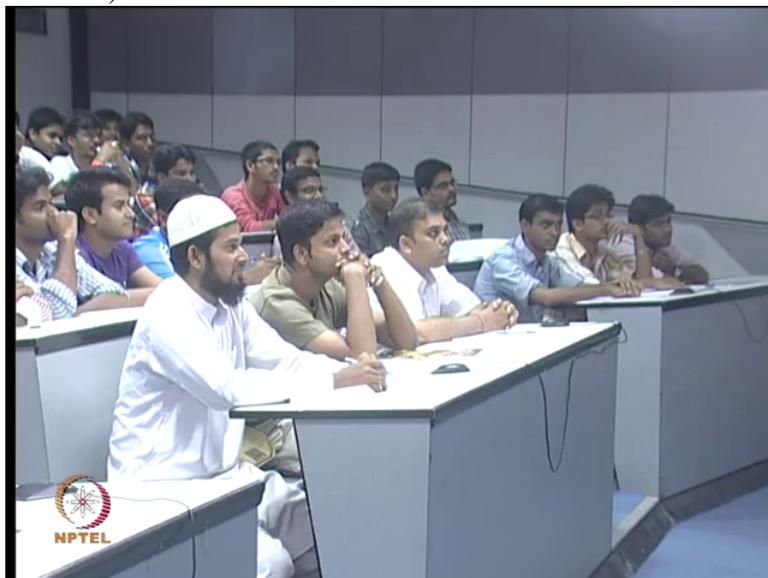


even two courses, Ok. And question number 9, maximum answered. Can you guess what is that question?

(Professor – student conversation starts)

Student: 0:02:30.5

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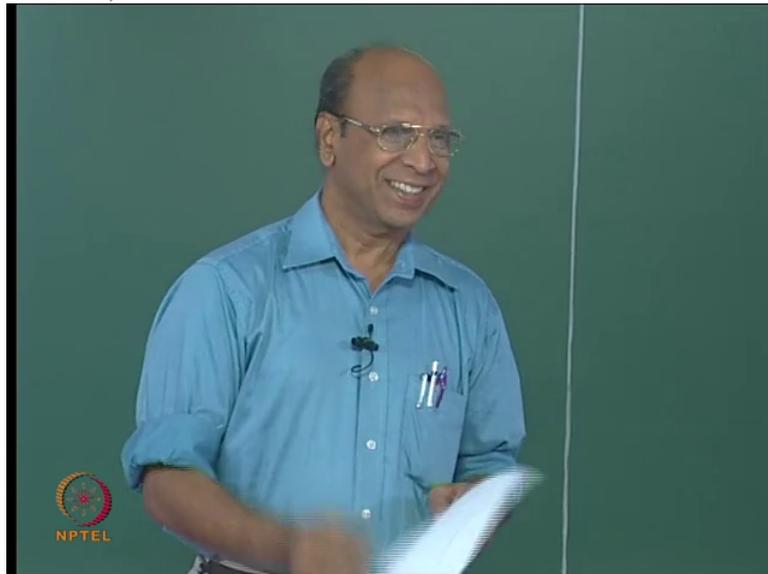
Professor: It is not 0:02:36.6 reactors

Student: Name

Professor: It is homogenous or heterogeneous.

Student: (laugh)

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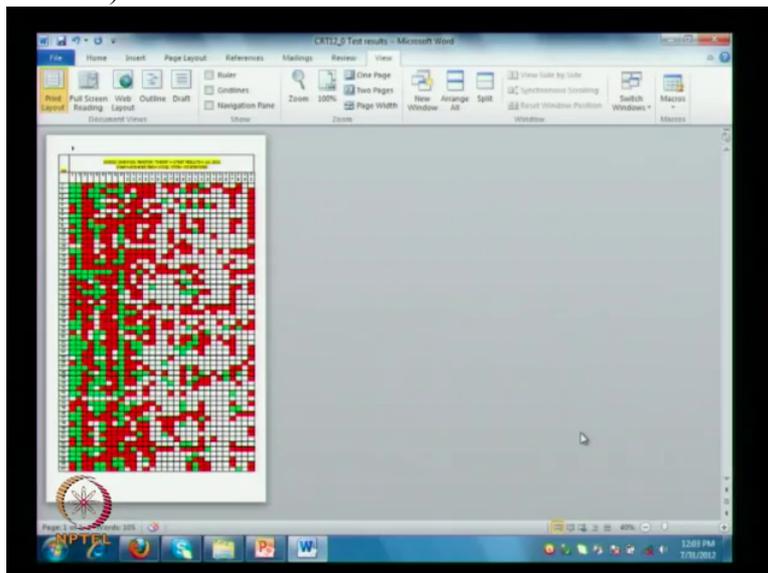


Professor: Single phase or multi-phase that is all. Ok, homo/homogenous (laugh); that is what the maximum number of people written without any mistake. It is really funny, you know. That is the only question.

(Professor – student conversation ends)

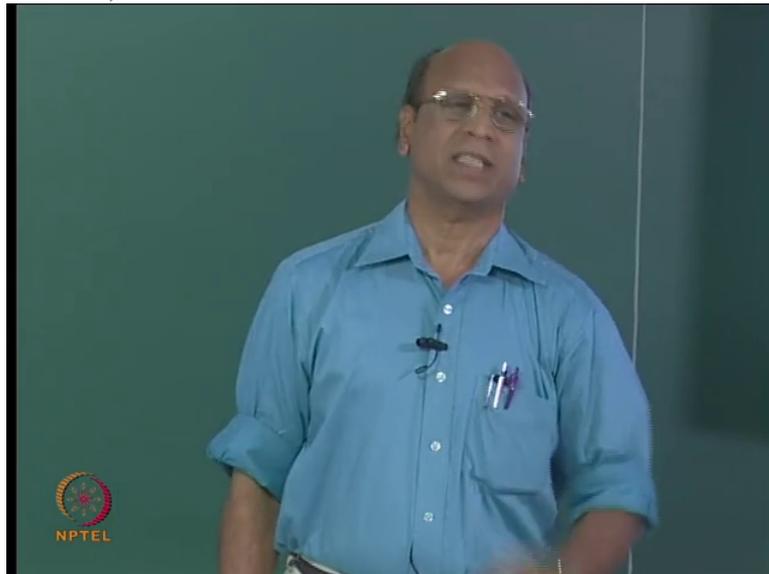
Even type of reactors many people not. Type of reactor question number is you know 6, 6 is not that much. 6 I think,

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this is the 6 one. Still there are many red lines. And also of course, I corrected when the entire answer is right.

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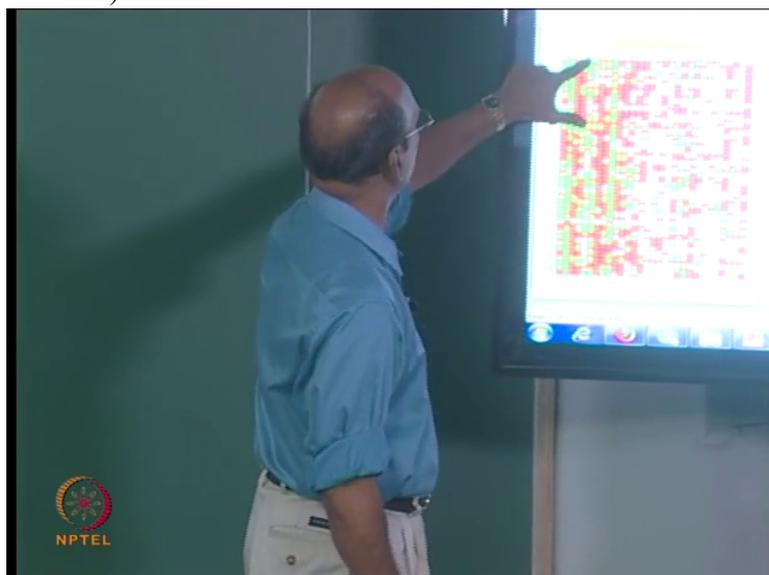


Not if they write only C S T R. Ideal reactors at this point of time you should know. How many are there, ideal reactors? Only 3.

If you do not remember 3 after 2 class/classes, 2 courses Ok then what kind of knowledge you have you have to check no? Self, that introspection. You have to check yourself. What is that we have learnt in those 2 courses, right?

And another one which is very popular question was this, fifth one, this is the one.

(Refer Slide Time: 03:52)



This one also many greens, can you guess that question. I know you are happy to forget but I think you know at least can you remember that question where many people would have answered? Just guess. Sorry. Selectivity and all, that is disaster. Many people did not...

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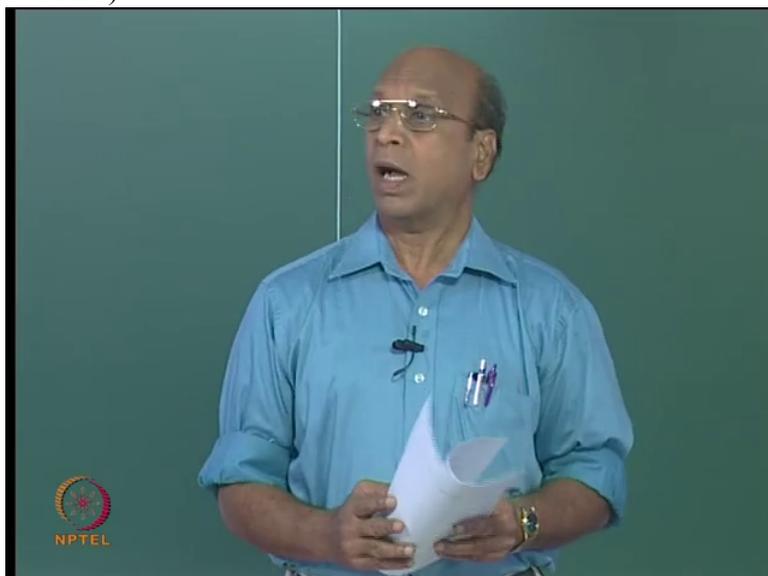
(Professor – student conversation starts)

Student: (laugh)

Professor: Many people did not write.

Student: Conversion 0:04:25.6

(Refer Slide Time: 04:26)



Professor: That is zero almost. Conversion versus temperature for exothermic endothermic reactions I think may be 1 or 2. I think that is question number....

Student: 0:04:37.8

Professor: Yes, that is methods for the analysis of reactor 0:04:42.8

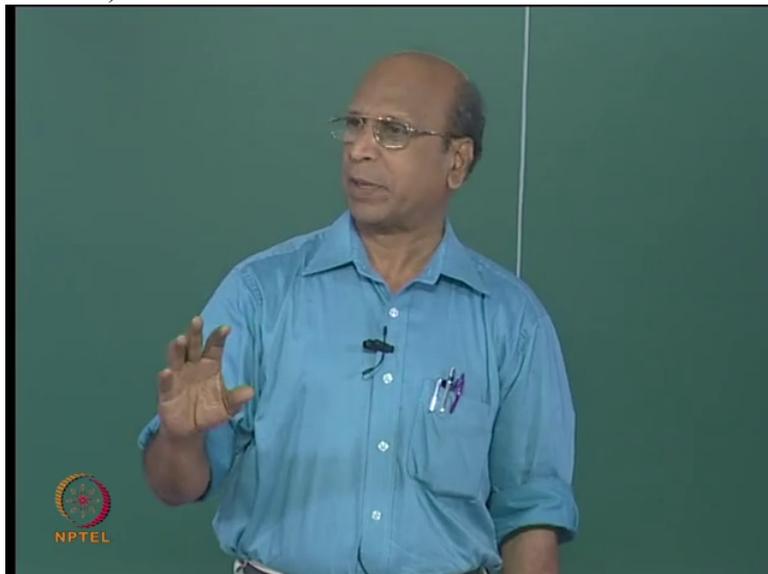
Student: reactor 0:04:42.8

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Professor: And that too I gave, I

(Refer Slide Time: 04:45)



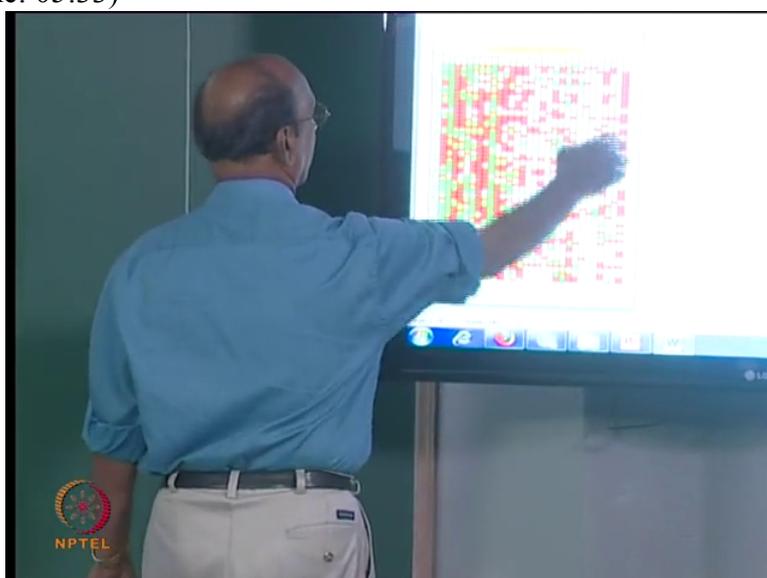
accepted if you can write 0:04:46.7 any two, integral and differential. You know another five are there.

(Professor – student conversation ends)

Yeah, half life method is another one. Excessive method you know, method of excesses, that means you take one reactant more, one reactant less. That is another method, Ok. And for reversible reaction you have to wait for long time and there is another method. So there are so many other methods and simply by taking you know the, what is that, regression analysis that is another method. All that no one has written, Ok.

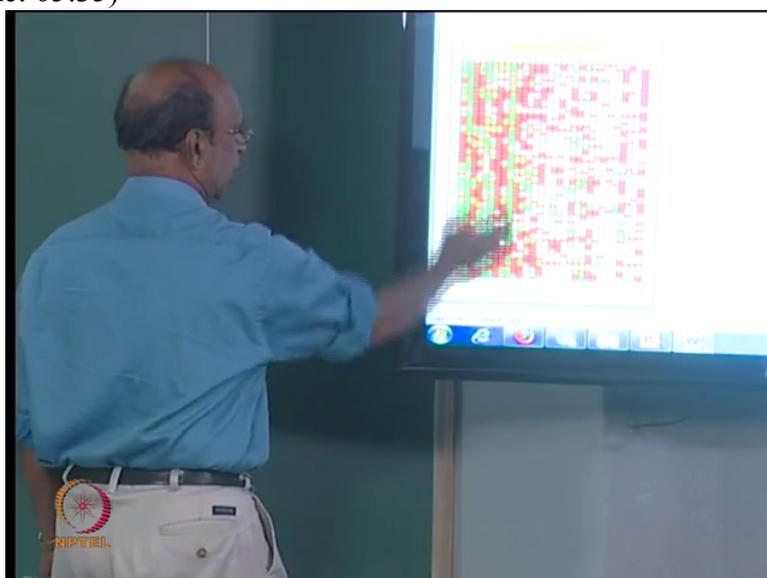
But these two I have taken differential and integral, that is why it is maximum. Ok, yeah and here are some green patches, Ok.

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And this is the, as I told you first 1 and 2

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chapters of Levenspiel, mainly the questions are from there.

And the definition of plug flow and mixed flow. Mixed flow almost everyone wrote. But I did not, because both I was looking for both I should get the correct answer, Ok. And plug flow that is not your fault of course. That is many, many, many teachers' fault. The definition of plug flow as axial 0:06:01.2 mixing zero, right and flat velocity profile that is not the correct definition.

The correct definition is something else. And if you know that definition, these things are automatically fulfilled. Like flat velocity profile and also axial mixing equal to zero, radial mixing equal to how much...

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(Professor – student conversation starts)

Student: Radial mixing 0:06:29.4

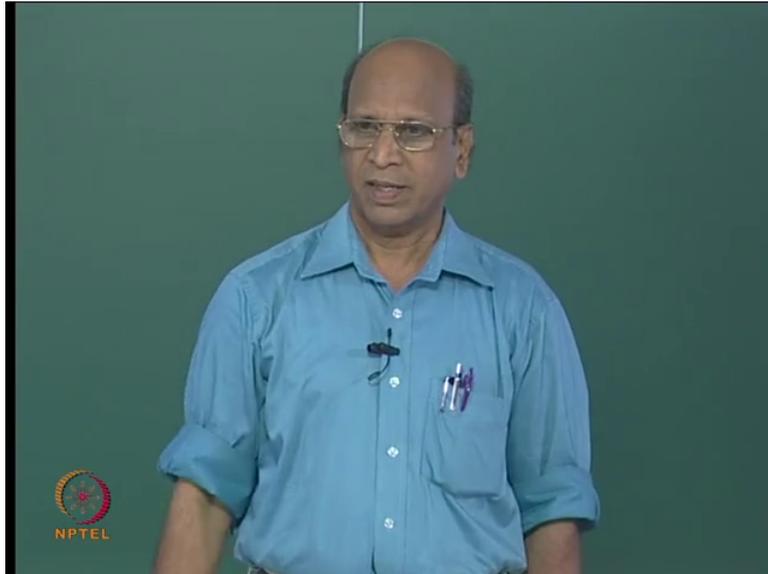
Student: Radial mixing Infinity 0:06:32.0

Professor: Louder

Student: Infinity.

Student: Infinity

(Refer Slide Time: 06:34)



Professor: Infinity. You have infinity radial mixing, axial mixing equal to zero and flat velocity profile. So for all these there is a basic definition and if you know that definition, all these things are automatic, Ok.

(Professor – student conversation ends)

I will ask the question saying that if you, you have written that flat velocity profile is plug flow. Why it should be plug flow? Why? Why do you call that one as a plug flow? And if radial mixing equal to infinity so what, why do you call that as a plug flow? Right. So that is why that definition is not correct.

Almost only 2 students, I think one must be from AC TECH and one must be from Osmania University, and both were my students who are teaching there, Ok. They would have told that I think. Only 2 people have written the correct definition. So I think this is not your fault.

I mean, here I do not blame you for this definition because the teacher would have not even known that particular definition and as usual teacher would have simply told that yes, assume flat velocity profile if you have or you want to have plug flow. Or axial mixing equal to zero if you want to have plug flow.

But the real definition we will discuss, you know, sometime later when you come to the reactors. So that is why I think it is a really disaster. I, you know, teaching of C R E is not that easy, right and this comes at the end. And surprisingly every chemical process starts with a reaction. But we teach at the end, end of all other courses, right?

You first, what is that, material and energy balances, then you go for thermodynamics, fluid mechanics, heat transfer, mass transfer all that at the end only reaction engineering comes. By the time you are tired you probably do not remember anything. Ok in two years itself you are tiring nowadays.

So that is why I think probably you would have not concentrated and in the GATE also I think not many questions will come, correct because in India it is only examination. There is no education in India. Only examinations throughout the country and all your minds only go for how do you crack the examination. How do you crack the question paper? Ok.

Yeah that is the reason why absolutely, I do not know whether I conduct the same, similar questions or similar examination in mass transfer or heat transfer what kind of responses I get. Ok and I appreciate myself because none of you will appreciate me. So I appreciate myself thinking that I have done a very good job of giving the test when you are not aware of

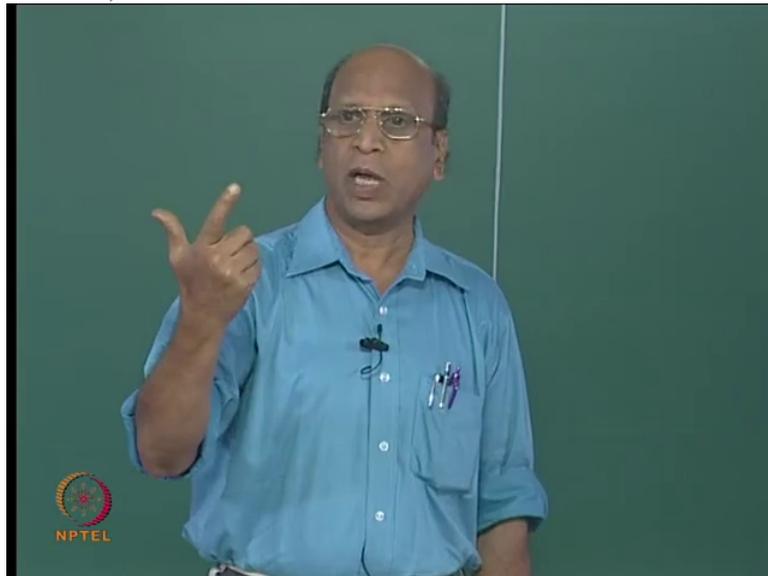
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the fact that I am going to conduct the test.

The moment you come to know that I am going to test, you will now,

(Refer Slide Time: 09:34)



you will have a race. That is why I like that movie you know 3 Idiots Ok where that funny word is given. So they want to crack that word. So that is why you forcefully pull the hair and pull your legs and all that you pull and finally there is no answer there. Ok.

So the moment you come to know, that is why gentleman agreement for you also next time, you should not inform your juniors that this examination will be conducted. So last 10 years I have been requesting your seniors and I think they are faithful, most of them may not be telling you about that.

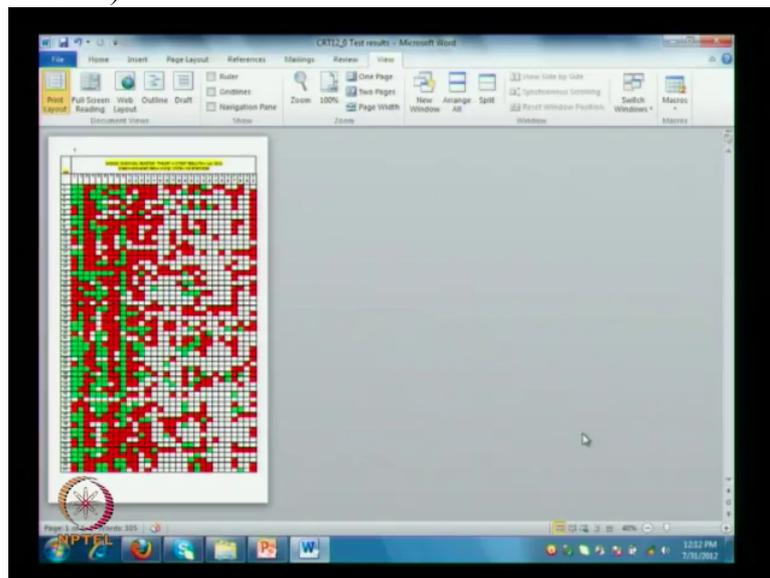
That is why I never give this question paper. I will only tell the questions. Ok I will never give you this question paper. Because the moment I have the question paper you will have a question bank in hostel. Then again you...anyway this fellow conducts the first examination on the first day, the July's examination on the first day, so now let us crack the examination. Cracking examination will not give you any idea now what I have to concentrate. So this definitely tells me that I have to concentrate from zero onwards.

Ok so from basics again, after 2 courses. And I strongly believe that whatever is left with you in this examination, whatever you could write, whatever is left in your brain only you could write there. So that is the true knowledge what you have. See the, you may, all of you would have got, you know, here we have S 10 out of 10. And in some other universities you may have, you know, your marks, is it Ok? You would have got 100 out of 100 or 90 out of 100 or 99 out of 100 in C R E.

But all those marks are only on your mark sheet, not here. And mark sheet is always in your cupboard. If all that knowledge with that 100 percent marks knowledge, if it is in your brain, then all that should have been beautiful green. Correct, no? The entire thing would have become beautiful green.

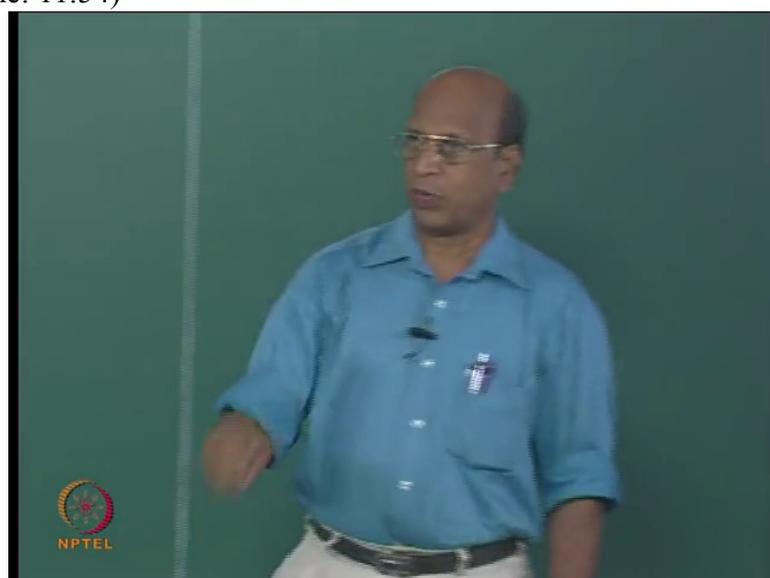
And it is disaster to just think about non isothermal thermal reactors. That is where these red patches mainly.

(Refer Slide Time: 11:50)



These are all non isothermal reactors.

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Like for example, non-adiabatic, non-isothermal. You thought that non-adiabatic is different, non-isothermal is different because there was a comma. I was asking about only one reactor, what is the name of non-isothermal, non-adiabatic?

Ok we call in short, in some books also it is written NINA, non-isothermal N I, non-adiabatic N A, Ok. So that is the kind of name we give for one non-isothermal reactor where, of course temperature changes are there and heat also is, you are supplying heat or removing heat. Not leaking heat and all that, some people wrote leaking heat and all that.

Either you supply or you remove heat and naturally the temperature will change, so the adiabatic means you are not supplying anything. So that way it is called non-adiabatic and also non-isothermal because temperature varies depending on what kind of reaction is there inside the reactor from starting to the end if it is plug flow reactor or if it is mixed flow reactor, will the temperature vary? Throughout the reactor it remains the same.

That is the beauty in definition of perfect mixing. Ok, so that is why every time this reveals me, you do not have to really worry. All Indians are brothers and sisters. This is the same pattern which I am seeing last 15 years.

(Professor – student conversation starts)

Student: (laugh)

M So our genes have not changed. So we are still Indians, no problem. So after taking two courses that is the result.

(Professor – student conversation ends)

So I feel at least by taking this course and then there is another course called catalytic reaction, this is chemical reaction theory; if you take both the courses I think that entire field will be green.

And what kind of questions I asked? Are they difficult questions? In fact many times I feel that if someone else is outside, they are all silly questions. Ok. How do you analyze the data? What is a chemical reactor? OK and what is the information you get from kinetics?

What is the information you get from kinetics? You get only one thing, rate of reaction. They write, you write rate of reaction plus rate constant plus order of reaction, all these, they are already there in rate of reaction.

Then what do you mean by, you know, order of reaction is a bad concept in your mind because many reactions do not have order of reaction. Always our imagination is only in terms of L K G. Because first time we teach, oh first order, and then solve all the problems; that is recorded in your brain all the time. You will never grow beyond that.

And if you go to, Hougen-Watson model I asked what is the information you get from Hougen-Watson model that is one of the questions. Not even one wrote the correct one, Ok. May be one or two people. You get only one rate expression that is all, nothing else there.

Ok, rate expression for catalytic reactions where it is a very peculiar rate because you have in the denominator, yeah, in the numerator something Ok, if it is simply a going to r, reversible reaction, just simply a going to r, first order reaction and then this is taking place on the surface of a catalyst so it is a catalytical reaction then we have the steps of adsorption, desorption, surface reaction all those steps.

If you take one of the steps as rate-controlling then you get a rate equation called minus R A equal to some constant, I am talking about numerator, some constant into P A minus P R, these are the, either C A, C A also you can put, C A minus C R by some equilibrium constant divided by 1 plus K A P A, K R P R Ok C R instead of P R, so that is one.

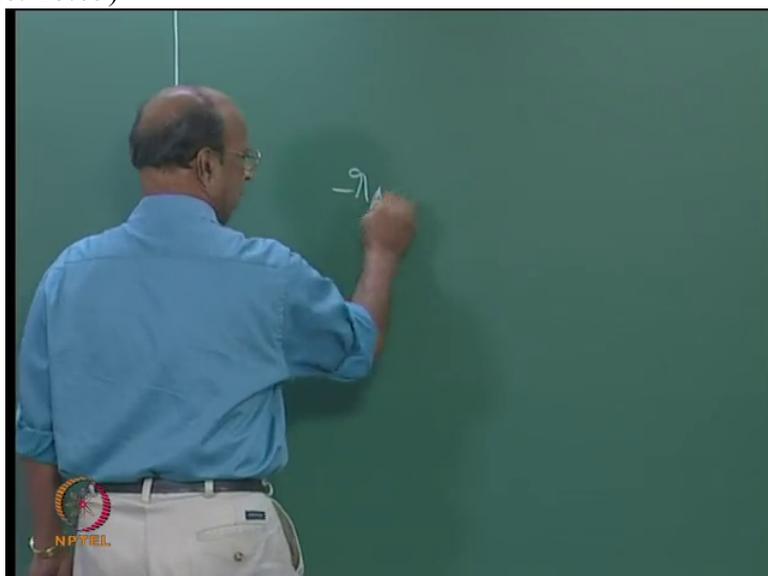
What is the order of this particular reaction?

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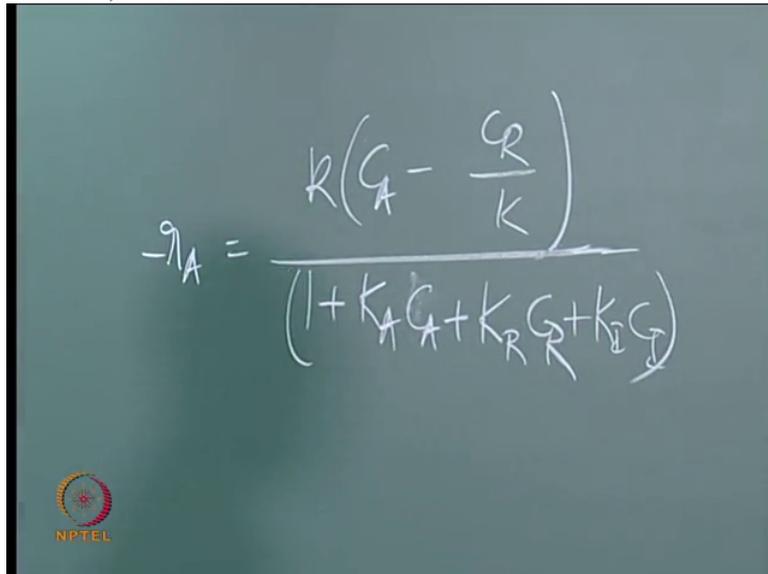
Can you tell the order of particular reaction? I think I will write that.

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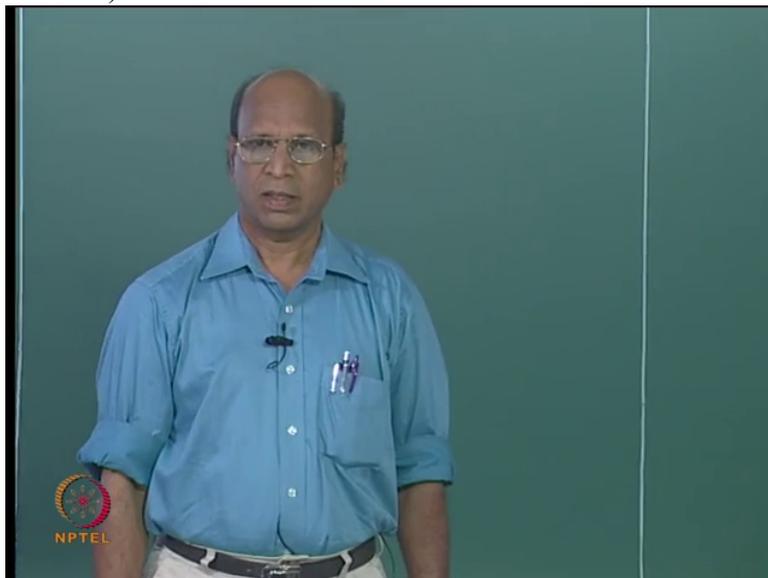
This is minus R A equal to K. Ok let me write C A so that you are comfortable with that, some constant plus 1 plus K A C A plus K R C R. If there are some inerts, you can also write that is K I inerts, concentration of inert. That is the one.

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$$-r_A = \frac{K(C_A - \frac{C_R}{K})}{(1 + K_A C_A + K_R C_R + K_I C_I)}$$

What is order of this reaction?

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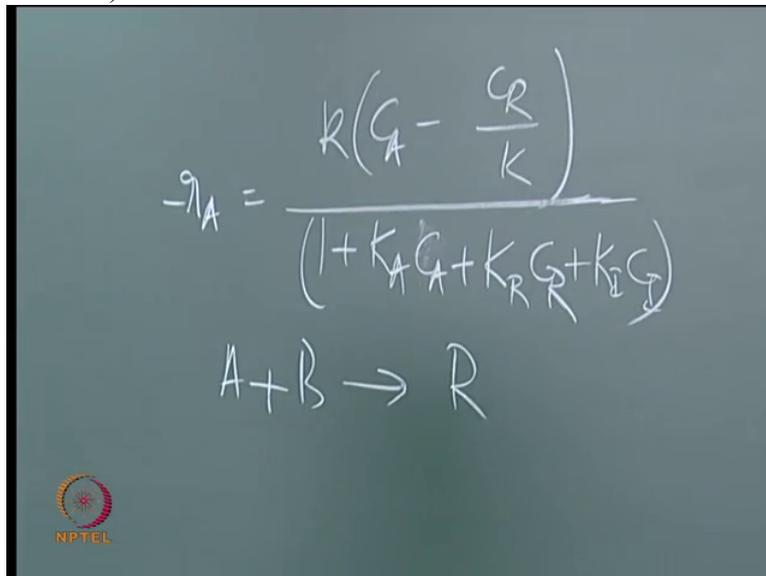
You do not have an order for that. It is a rate of reaction; that is all. Like that, like you know more on kinetics you know, in 0:16:50.4 bio-chemical engineering, right. That question also I asked, bio-reactor, is it different from chemical reactor? Many people wrote you know they are different. No, both are exactly same. Both are exactly same.

Absolutely there is no difference. It is the same plug flow reactor you also use there, same batch reactor you also use there, same mixed flow reactor you also use there, right. And you also have a minus r_A there. What is that minus r_A ? Given by these microorganisms called

Monod's equation if it is microorganisms or if it enzymes it is Michaelis-Menten equation
0:17:28.0.

What is the order of Michaelis-Menten equation? It is a complex form similar to this only. So you cannot say that you know this is the order of reaction. That is why the constant of order of reaction is totally wrong for us. You are very lucky if you have a first order reaction. That is one of the very, very, very, very special cases. It is not that, you know every reaction should have first order. So that is why you know very, very basic questions like when I have A plus B going to R what is the order of this reaction?

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(Professor – student conversation starts)

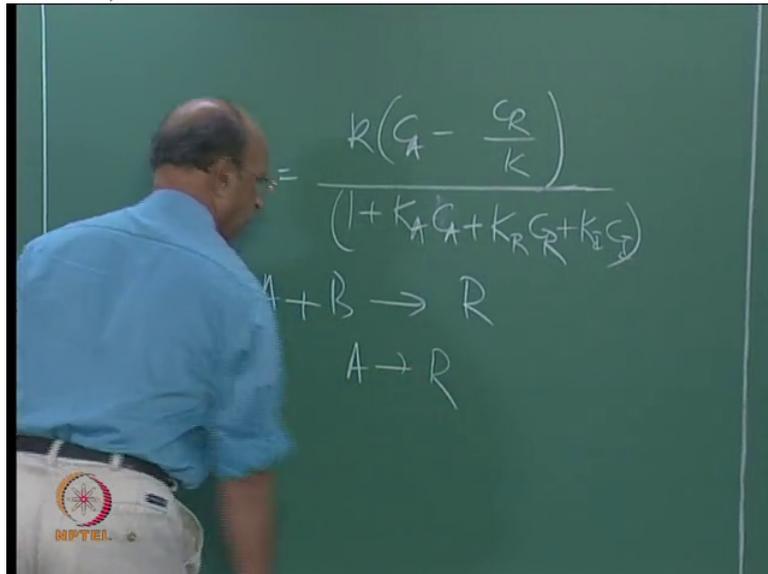
Student: 0:18:12.0 cannot say

Professor: You cannot say anything about that.

(Professor – student conversation ends)

It is so innocently looking, you know. Even simpler one is simply A going to R, simply A going to R.

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What is the order of that reaction? We do not know. It can be as complicated as this. Or if you are very lucky then it is only first order reaction provided there is a clause there, if it is elementary reaction.

And how do you know it is elementary or non-elementary reaction? By looking at that it will never. It will never tell you, Ok I am elementary reaction, you take first order. Same thing, are you telling me, when I am looking, I am so and so, are you telling me? You do not tell, Ok.

Similarly there also. Reactions also will not tell. So it is our duty to find out. It is my duty to ask you, Ok what is your name? So I cannot assume that because in, because you have come to Tamil Nadu and in Tamil Nadu most of the time you will have Subramaniam, Subramanians or Srinivasans Ok, so I then cannot simply say, that Ok, Srinivasan come here. Ok or if you, I think in particularly in Korea it is beautiful. 90 percent of the people are Kims K i m, Ok. You can call Kim means 100 people will look at you on the road. Which Kim we do not know (laugh). Ok. So like that I think we also you know this kind of names particular to some regions.

So because you are going on Mount Road here, there is a, there is a place called Mount Road in Madras, Ok, you are generally walking. You say Srinivasan means 100 people who will look at you. There are 100 Srinivasans there. So we have to find out which Srinivasan you are finding out.

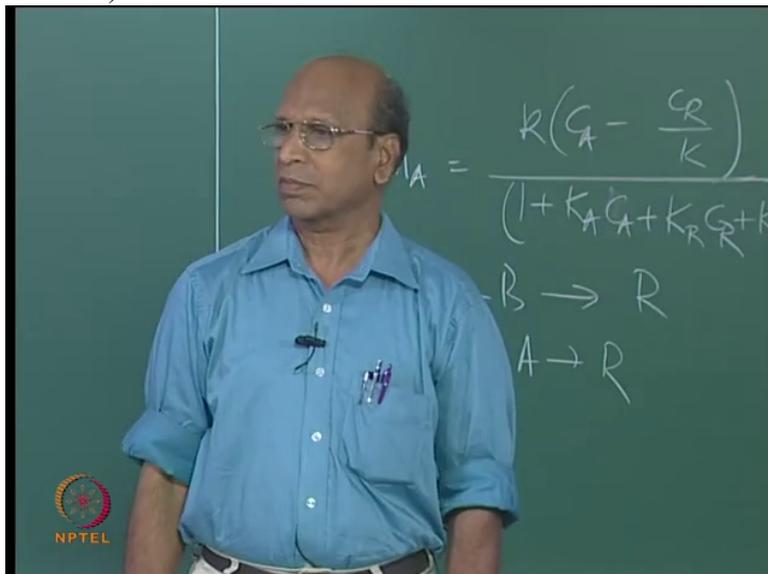
So similarly any stoichiometric equation, you should find out what is the order of reaction

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without having in your mind that this is first order, this is second order,

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Ok. So that is why, it is really, really, I mean, I do not blame you but I think we do not know this knowledge we require a lot for C R E.

So that is why I have to now start from, from the scratch and then with a clean slate, everything is erased. Now I think all your hard disks should be completely cleaned and now you have to have fresh. But student does every time, every semester he cleans his hard disk.

(Professor – student conversation starts)

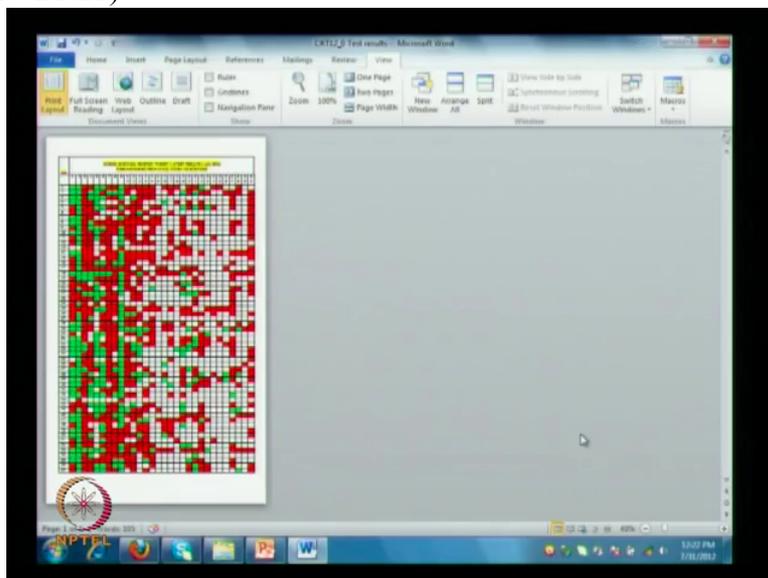
Student: (laugh)

Professor: So that next semester he is fresh. That is what would have happened here. So where is the memory? Memory totally gone because you are erasing. Because you want to be fresh in the next semester.

(Professor – student conversation ends)

So whatever C R E 1 you taught, you know, you have taken last semester, you come with a very fresh face as if C R E 2 is fresh again. No connection between these two. Either mass transfer 1, mass transfer 2. Ok. That is what would have happened here. Right and that concepts,

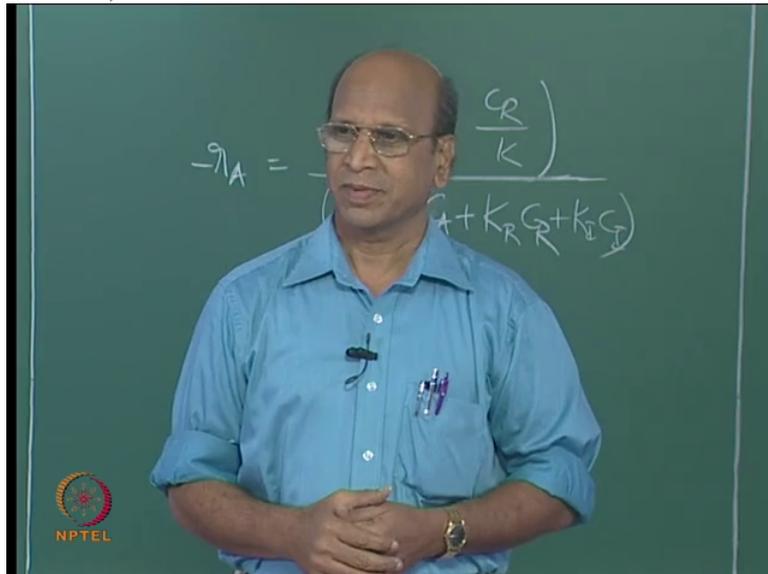
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last question.

All reds and un-attempted. What is a concept?

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I think it is very difficult question to answer also, right? So that is why at least what are the two concepts that you have learnt, that is what I have given the question. Minimum two concepts. Ok.

Some people, you know, they have written ideal reactors. Ideal reactor is not concept but the definition of ideal reactor is the concept. For example plug flow is a beautiful concept. It is really wonderful concept. I will tell you when we come to that, why it is beautiful, Ok.

So that, that means you conceive something in your mind and then to find out whether your idea is correct or not. That is what what you do most of the time in research. You see something and then you assume or you hypothesize in your mind, Oh this must be happening, right. And you say that Ok, this is the idea I am conceiving. This must be the concept, Ok.

So you have to now to prove that what you imagined in your mind, what you have conceived in your mind and what you have really found out, both are same. How do you find out that? Either theoretically, by solving some equations, by writing equations or experimentally or both. Then only your concept is right, your hypothesis is right, whatever you imagine. That is what is research that is all.

You just look at some problem, no one would have told anything about that problem. No one would have addressed. For example global warming is one of the problems. And some people

say there is no global warming. Simply the weather changes. And some people say, no, no, no, no it is clearly because of global warming. Who is right?

We have equal number of people? Entire planet is divided into two now. Some people say no, some people say yes. How do you find out as one of the researchers? You imagine global warming means this. Everything is in our mind. You imagine that. Ok global warming means this should happen, this should happen. So theory wise can I calculate and then show them this is really happening.

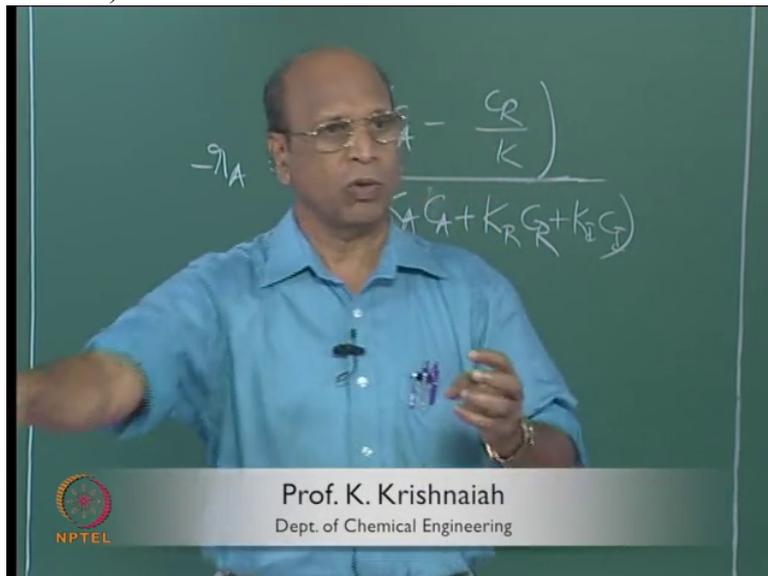
Or theory also many people will not believe. That is why, Nobel Prizes also, if you only produce theory, there is no experimental verification, they never get the Nobel Prize. They must be, there are many theories. That is what you know, Higgs boson person 0:23:54.4 he also, he does not have Nobel Prize.

Higgs Boson recently, they are starting no, it is a particle where that gives the shape to the world. Whatever we see, the planets, the solar system, and galaxies what we see now, all the 0:24:12.7 stars we see, the shape came because of that particle. That is a theory.

Theory is that, you know, if you believe Big Bang theory, theory is that at the point of Big Bang there was no volume for that small volume, for that small dot whatever is there somewhere in the universe. Because of some conditions, this got exploded. And what was there in that dot was it is pure energy. It is a wonderful example for $E = mc^2$.

We know how to convert mass into energy, mass into energy. Take coal, burn, you get energy. Because I am taking mass. But you do not know how to take this energy and convert into coal,

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correct no? You do not know. So that is the reason why at that point of time, all that pure energy that was there, that has exploded and now it has to convert to mass. Then we do not know how to convert.

So that is why at that time who believed Big Bang theory, so they started imagining and this Higgs told that there would have been a particle because at the time of a very big explosion, right, at the time of that explosion, there are many, many fundamental particles which have been formed. All those are theoretical particles, you know and some of them proved experimentally.

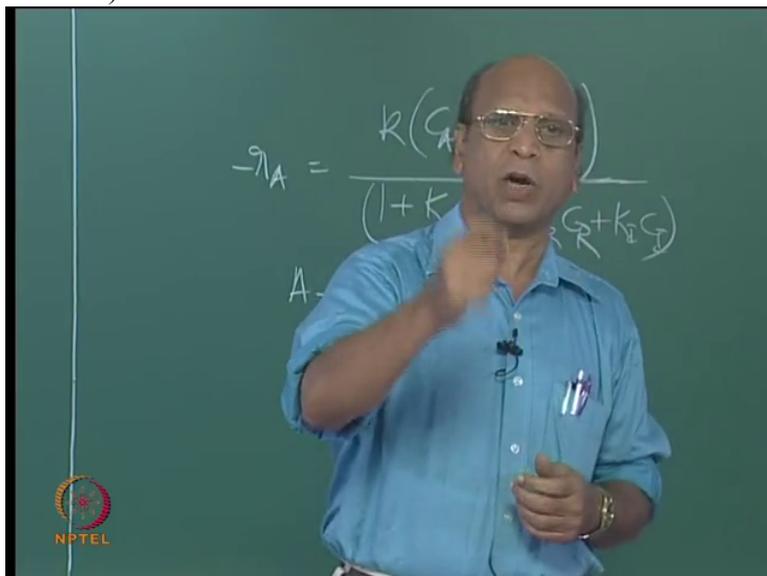
There are so many particles, there are leptons 0:25:34.9 and also neutrinos, yeah, bosons. Boson is one of these particles. So like that there are many,

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many fundamental particles. So what he told is one of the

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particles would have converted or would have interacted with that energy field and then it would have converted to the shape which are seeing now, that means the molecules.

Ok all the periodic table was being created at that time, you know hydrogen and then next one, next one, next one, like that. Ok what is that he has done? He has imagined in his mind how the explosion would have happened? What kind of fundamental particles were there? And one of the particles would have given this interaction between this energy field and then one of the particles responsible for the shape which were seeing.

All that is the theory 0:26:22.5. Same thing in chemical engineering, same problem in chemical engineering. Ok, we know how to design distillation column 0:26:29.8, right, one of the easiest design. And you, the design of distillation column is so beautiful; I really like it because that is supposed to be a mass transfer equipment, correct no?

There is mass exchange when you are separating two components you know by only purely mass is separated there from higher 0:26:55, lower 0:26:56 and all that. But you know any time you are using a mass transfer equation there? That is why chemical engineers I know, earlier chemical engineers were really great.

Wonderful methods they have done. Without even talking about mass transfer equation, there is no diffusion nothing, no equation at all. What is the procedure? You write the material balance, you will get operating lengths and then you go to thermodynamics, what you get?

(Professor – student conversation starts)

Student: 0:27:23.8

Professor: That will be there but what is that will finally give you from this procedure?

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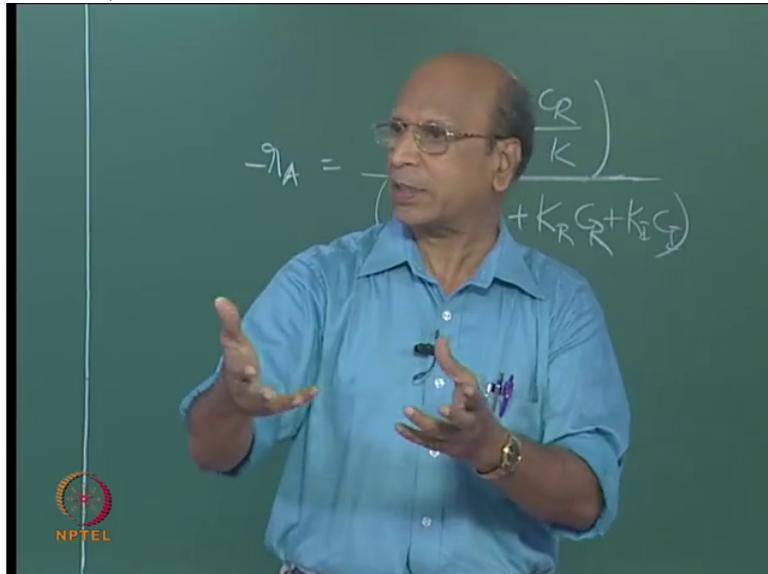
Student: Number of stages

Professor: It will not give you number of stages. Equilibrium diagram. Thermodynamics will give you only equilibrium diagram.

(Professor – student conversation ends)

So from thermodynamics simply take the equilibrium diagram, Ok, you are assuming, even enthalpy you are not going. It is the simplest case, Ok. And then from

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energy balance, from material balance you will get the operating lines, correct no? Then in between you write checks, checks, checks, checks 0:27:56.7 number of checks 0:27:56.7.

1 check equal to 1 stage. So 10 checks means 10 stage. Now you go to Murphree fellow (laugh) and say that Ok Murphree efficiency and if it is 50 percent then you will become, and you will get 20 p. Where is mass transfer coming there?

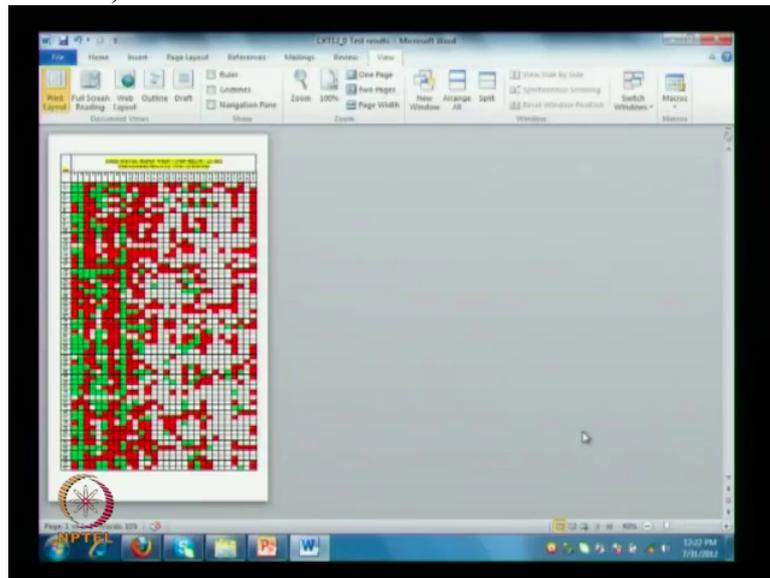
That is also bad for you. That means you do not know what is really happening in the column but still you could design. If someone asks, Ok now explain to me what is distillation, you cannot say that, Ok go to thermodynamics and get the equilibrium data and then you know go to mass balance and then get operating lines and then draw check, check, check you will get. That is not distillation.

Distillation phenomena is totally different. It is a wonderful phenomenon. Ok. Why the heavier molecules are moving one direction, why the lighter molecules are moving in one direction, why they have to go along the height of the column? By the time you are going to the top you are getting only the pure lighter component and then by the time you come down and then see the bottom plate, of course the number of plates and all those in our hand only, so then you will get one of the purest bottom products and how, what is really happening phenomena?

Have you ever thought? Your worry at that time was whether this comes in the examination or not? And old question papers. Yes, for every old question paper has one distillation column design. Ok, mug up. And then at least draw 10 times and then you will know. And at the time of examination you will write something you will be given some marks and then you get the degree.

That is what is happening

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there. That is why I like the German system where every examination has viva voce, every subject. Every subject has viva voce. If I talk to you only then you will know how much knowledge either I have or you have. Writing examination will not give me any idea whether you have knowledge or not.

Olden days yes. 30, 40 years back, yes. I mean if you have first class means definitely you know your subject. Ok. But now even if you have 100 out of 100, you may not know definition of what is air. I am not saying all like that, but you know, always statistics means more than 50 percent. Then we will say how many people do not know.

Because of the system, because we are not happy in learning something. All our aim is to get a job. Not for the happiness of the knowing knowledge and I tell you if you have that real knowledge in any field, whatever chosen field you have taken your happiness, your confidence totally different. That is why you know most of the God's figures, whatever

religion it is, they put a small circle behind his head, right and the head will be glowing, that hollow. Why it comes? It comes only because of the knowledge.

If you also have all chemical engineering knowledge, I can see that (laugh). I can see that beautiful hollow mark behind your head. I say oh, what a wonder chemical engineer! I can really appreciate when you are walking on the road, Ok that is the kind of knowledge what we want to have.

But I think you know, I am telling all this in the first class, this is only the first class and the next class also may be, it is the attitude change. Because we have done till now without knowing anything just for preparing for examination, just preparing for examination. But now I tell you there is happiness in knowing knowledge. And that knowledge there is no shortcut. It is just only through hard work.

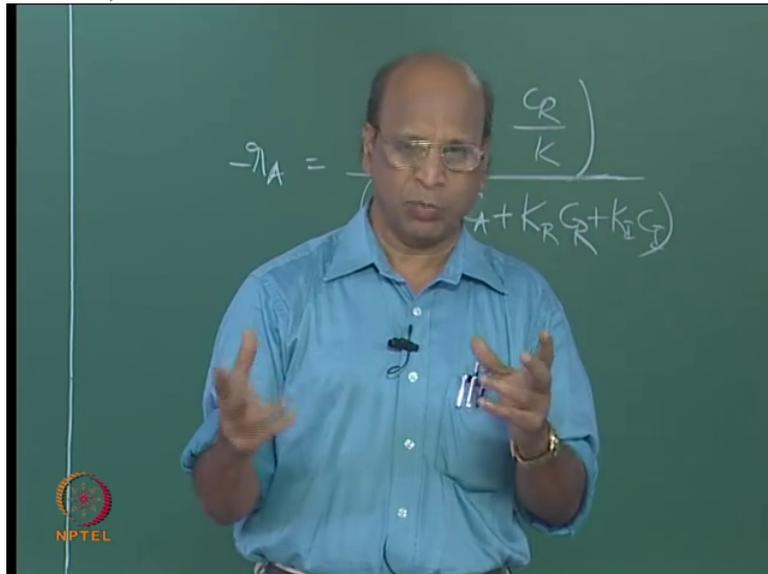
Ok and I wish this also should have been, like in

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movie, another movie, you know I

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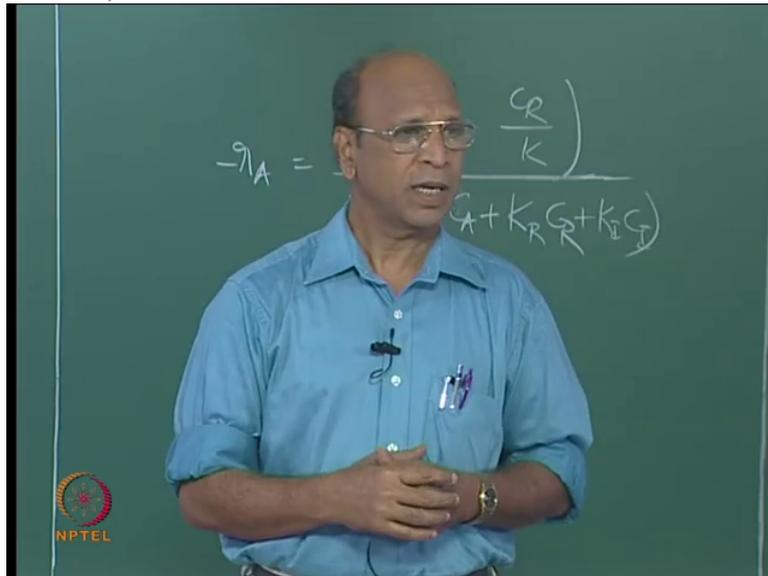
see movies and also I take lot of examples from the movies. I think how many of you seen Matrix?

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That is all? It is a so beautiful movie.

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I think unless you will not get grade unless you see that movie and come here, Ok (laugh).
Ok, yeah it is available in the hostel also.

It is a wonderful movie where, I think it is a science fiction movie. Science fiction movies have lot of innovation. That is why I like them. Innovation means something new. Avatar you have seen at least? Yeah many people have seen, no? There is one beautiful point. I do not know whether you have observed that particular point. That point is the pig tail of any person on that planet, you will combine with

(Professor – student conversation starts)

Student: 0:32:44.8

Professor: Yeah, Ok. Either horse they are riding or bird they are riding. You know what is the meaning of that?

Student: 0:32:51.5 connection

Professor: Connection, frequency matching, becoming part of that. Like that, today night you have to go to your room and then put your pig tail into C R E book.

Student: (laugh)

Professor: Ok (laugh) and I think for girls it is easy. For you, you have to find

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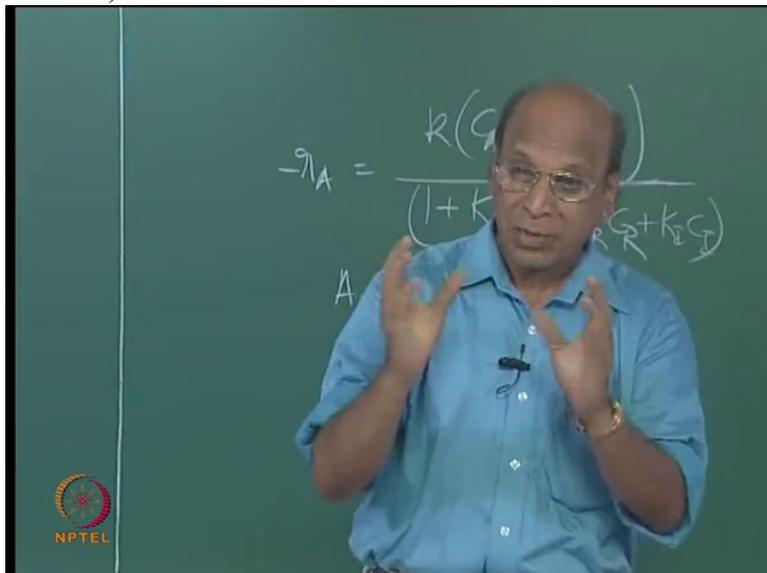


something.

Student: (laugh)

Professor: (laugh). Ok yeah

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then you will become part of C R E, chemical reaction engineering. Then everything, whatever is in the book automatically comes to you.

(Professor – student conversation ends)

That is also shown in a different way in Matrix movie where I think the hero wants to learn Kung Fu, right? So then someone says that Ok, load Kung Fu to him, like our C D. How beautiful it is! If it is possible to load all that subject in your mind, it is wonderful. I should

have liked C R E and also I should have liked Thermodynamics, Ok load Thermodynamics to me now and all the books that are available.

Ok, otherwise you have to become, you know, another robot in that movie Shankar; they have taken a great movie, it is a really beautiful movie, great innovation again, Ok. Just reading tick tick tick tick like this it goes, Ok any page, any line, any word he can tell. How beautiful it would have been if all of us are like that.

Wonderful no, this question is not required, this class is not required by the way and I lose my job. (laugh) Ok because this is not required simply. Because I get my job only if I innovate something new. See that is the kind of thing. That is no, we have to show that interest in the subject and I tell you it is very easy to waste time in any place.

And there are sufficient of your friends who are masters of wasting time. Ok, they will simply, even if you want to read in your room, they will just pull your hand and Ok, say let us go and take chai/tea tea. After chai/tea we will start. And when do you come back after chai/tea? 2 o'clock in the night.

(Professor – student conversation starts)

Student: (laugh)

Professor: You could have gone at 8 o'clock in the evening, 2 o'clock you come. Then what you learnt?

(Professor – student conversation ends)

Because your body asks Ok sleep now because we have a rhythm on this planet; night time to sleep, day time to work, right? Yeah these day and night only came on this planet only to find food whole day, that was the original idea, I think even now, except humans, all other species do that same thing. Only humans do many, many bad things.

Ok, really correct, no? You have many monkeys you can see. That is why all these points I have mentioned in my welcome speech that day. I think one of you would have remembered now. Ok I told even this no, Higgs boson also, all our faculties are Higgs bosons, so please

interact with them so that you will get some kind of mass, a better mass, Ok. All this I told you on that day also, right?

If you would look at our monkeys, then what do they do? They would always be searching for food. So after 6 o'clock you do not see any monkey. Only monkey see us. Because we will be people who will be moving all the time, throughout but monkeys will be sleeping or just you know, on the trees they will be there, right. Any species you take, that is what is the idea.

So that is why, you know what happens is; now I know you will very quickly go to that slot, what is the slot? When I ask you, Ok where were you yesterday? Sir throughout night I have worked so day time I have not come here. Most of you are going to tell the same thing when you are doing your projects, most of you which is a very, very, very bad habit.

You are not designed working and only watchman. Why do you have watchman? We also do need them. Because we are also wrong people so to protect us I think there is another watchman, that is all. Otherwise which monkey has watchman? Which birds have watchman there or watch girl of watch man whatever? Yeah I mean which species have police? Which species have military? All are wrong concepts, no.

So if all of us are only searching for food on daytime, because this lecture will give me the food that is why I am doing this job. So that is why you are searching for the job so that you will get the food. And if there are sufficient number of forests, sufficient number of trees you know where you get fruits and all that. We do not have to job. Actually I am praying for that. I think you know when without doing job, whatever you want you can happily do if the food is available.

Ok, so because we are also capable of producing more and more human beings so that is also, you know, that is why global population is increasing and this is finite space. Globe has a finite space, finite area so number of trees are limited, number of forests are limited and we are going infinity way. Our population is increasing. That is why this problem of rationing, queues; queue everywhere, any ration shop you have queue.

Again you tell me which monkey has these queues to get the food. Because that is the nearest neighbors you know, for us monkeys. So that is why you can always tell them. So if they

want food, they will go and search. Because we spoiled them, in fact. If it is a forest with full of fruits very happy, whenever it is hungry it will happily go, eat fruit and then happily sleep. And of course that race started because of the reproduction. So it will reproduce, that is all. Any species only has to reproduce otherwise it does have life. One definition of life is that, which is capable of reproducing its own species, Ok. So that is why I request all of you to have that mind to learn, not mind to crack the examination.

I know some of you would have asked about me, whether this guy gives more assignments or less assignments. I know, definitely you would have asked, right? Because for M Tech students, they do not have choice, poor guys. Even you are told that he gives a lot of work then you do not have a choice. It is a core course for you. You will have to take.

But M S P h D, definitely will optimize. Who is the teacher who gives no assignments? And who takes minimum number of classes, may be 10 or 12 in a semester? What do you learn if you have that mentality? And I have, I have many people here who have that mentality in our department. Your seniors also will be happily telling this information to you. No, no do not go to him, he will kill you. He will give lot of work to you.

What is this? I think if you want to have knowledge, you should do lot of work. There is no other way of getting knowledge. And what is the use of this knowledge? Your happiness I say. Not even job. Your happiness, the moment you know that you know something, you understood something, your confidence, your happiness inside. It is the self-happiness which is very, very important at the end.

And most of us have forgotten about our own happiness. You will only try to satisfy others, mother and father, brothers and for them only I know. Because even though you do not have any interest in coming to I I T, your mother and father should have pushed you here, literally brought you and thrown you here and then gone. There are some people, I mean 5 to 10 percent like that.

Because your interest may be drawing painting, or your interest may be playing something. All that is gone, right? So that is why my request to all of you is only to find out your interest

and also try to learn something whatever interest you have , whatever subject you like. That is very, very important for all of us. We will be happy, you will be happy if you learn that.

And the only way to learn is work hard. I am not asking to work hard alone. In groups you learn much more. You form some 3-4 people together, Ok. And I know group copying but group discussion I have not seen in the hostel. One guy will do assignment and tomorrow morning you have to submit and throughout night that day that copy will be flying here and there. Ok.

Same copy will be moving here and there. Copying, copying, copying and I think you know by copying who are you cheating? You are not cheating me. When I give you the assignment and I ask you to solve, without solving, copying and if you give me the assignment who are you cheating? That is all, yourself only and self-cheating is very bad, Ok. And that is what happens. I know all of you, even though I tell all this; definitely you are going to do whatever I told not to do.

All of you, because you are very busy, somehow you do not know, you will not have time to solve the problems when it is given. You will wait till last day. Last day anyway you cannot solve. Then you can see for who has solved, where I can copy 0:42:21.8. That is what is going to happen.

But if you plan very well, management of time is very, very important for you, Ok. This is, after all you are not studying lifelong, guys. You are only studying, I think after you come to I I T, maximum is only 5-6 years if you do P h D. If it is M Tech only two years, minimum time required.

We do not have any degree less than 2 years. We have a diploma for some other people, especially for Metro and all that; that only recently we started. Other than that, minimum time here to be on this campus is 2 years. So in these 2 years what you learn, and after 2 years you would not, you may not be even thinking of learning anything.

That is why at this point of time please try to learn as much as possible, interest and I also tell you, the mentality of the student is they will try to listen first. And if they are not able to properly understand then second day also they try, may not be understanding to them. Then

third day they will switch off the brain. They will come to the class, sit down, they will laugh when I put a joke, and, but still nothing is going to their mind.

So that is why whenever you have doubt, if you are not able to understand better immediately to ask doubt and all the teachers will be very happy to clear doubt whenever, you know, then and there. You do not have to wait even end of the class. But I know you do not ask the doubts. Why? You think that other people will laugh at you.

You think that other people will think that Ok, you are now trying to butter me or try to satisfy me, try to be friendly with me, with the teacher me means here. So that is what other people think. Let them think. If you have a genuine doubt, genuine, if you do not have genuine understanding then definitely you have to ask. That is why questions should be put. In fact we learn a lot because of your questions. Ok.

So that is why these things and another thing also I want to tell you is even though I think you know technologically we are progressing very well, everyone has a cell phone, everyone has T V's and I think your satellites may also come to everyone later, even though we are advancing so fast, but still our communication skills have not improved so fast.

This S M S is spoiling all our communication. Because there is no word, you means only u you put. Are means only single r you put. No full stop, no comma, Ok no words, then if you write, some people are writing the same thing in the question paper answer papers also.

Because they do not know, they do not know any other language except S M S language. Because before he was born, this cell phone was ready with him, Ok. Mother and father will be happy to give them cell phone, safety wise. So those people will use only for this, right. That is why communication is very important.

And one way to learn on this campus is you have to take an oath that you should not speak in your mother tongue as long as you are here. Mother tongue only for mother. All other people you only have to talk in English right now. Forget about Hindi, national language and all that because ultimately that is the only language where we are communicating.

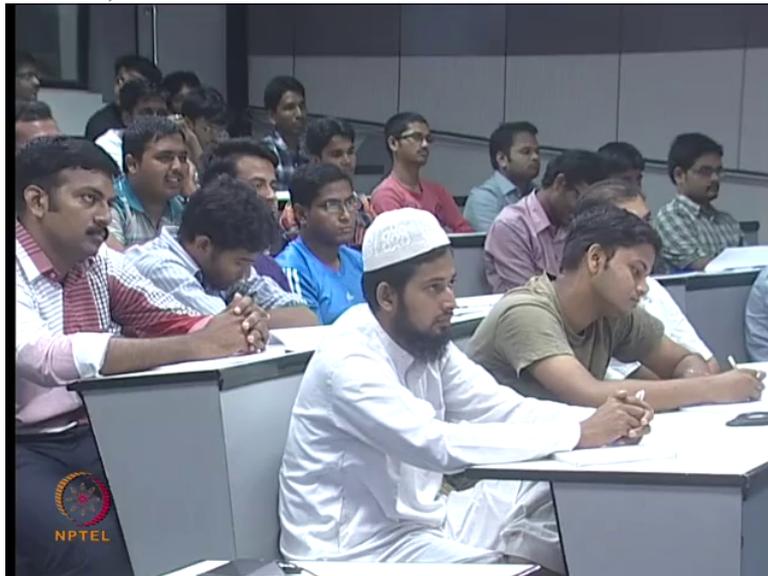
If all our medium of instruction is Hindi, and also I am talking in Hindi then fine, I mean that language at least, like Germany they talk only in German and not English. And Japan they talk only Japanese, Chinese they talk only Chinese. But India only we do not have. You know that knowledge has still not come. All the degrees are in English.

And many people not able to write their, you know questions properly. And of course thesis is a disaster. That is why you have to communicate. Now I think that is why we are very seriously thinking to have communication courses even for M S P h d scholars, technical skills and all, I mean technical writing skills, communication skills, right. So we are seriously thinking.

I think with your batch, now I think today or tomorrow I will send this circular to all as a, in academic research to all H O Ds to identify who have these less communication skills and then we will arrange a course for them separately. May be 2 weeks, 3 weeks like that. So that is why, one way to learn English is that do not talk in your own mother tongue.

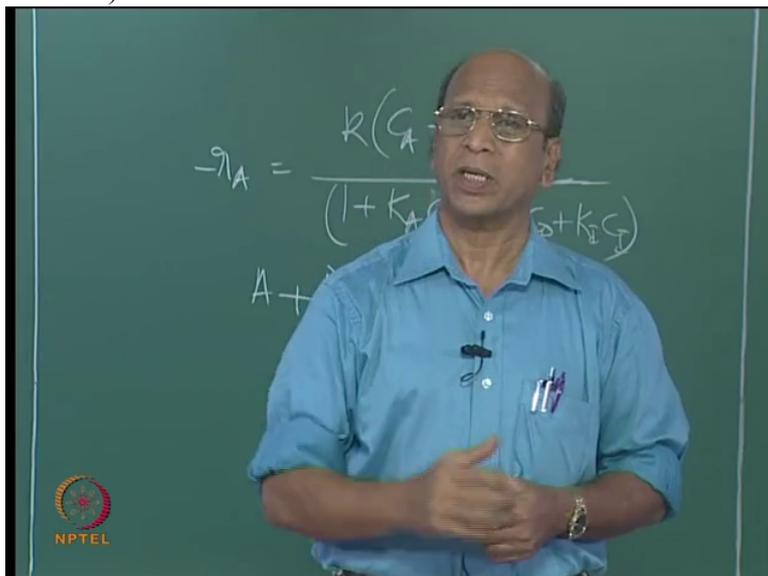
Particularly I am telling people from Andhra. Because that fraction is more here. And the second largest fraction I think is Hindi. Ok, so please do not talk. I know you talk only in English.

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Then I think you learn something, definitely you will learn. Ok that is very important.

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You are not able to communicate. You do not know what to tell if you want to talk to me on some point, so that is why that is one thing which can you improve. It will definitely improve if you are everyday conversing with your friends. It will definitely improve. Many people we have seen.

In fact 10, 15 years back I think, this, you know that one particular or two particular languages were not there. All of them were beautifully communicating in English, Ok in the hostel. But now you go, I think lot of places in hostels when you walk you hear either Telugu or Hindi. And occasionally Tamil also because there are some few people are there.

But we should listen only in English then only your communication will improve. Now please really listen to me when I am taking, you know, when I am telling all this. This is a very important for you and you will be a different person. If you take all my suggestions you will be a different person by the time you leave.

Another thing is maintain timings. One general thumb rule for your self-discipline is that, there is any class, for example 8 o'clock class. Try to be there at 8 5. You need lot of discipline to do that. If there is a meeting where you have to attend, Ok, that meeting let us say 3 o'clock, try to be there at 2 55. It is not easier; you know the way I am telling. It is very difficult to do that. Just determine yourself you know, Ok I want to be there 5 minutes before, whatever event I am going to attend, either class, either...even movie also. Try to be 5 minutes before.

That will tell you whether you are disciplined or not first of all. Even for mess. Mess is opened at 6 30 means try to be there at 6 25. You need lot of planning. If you want to be there at 6 25, when you have to get up? How much time it takes for bath? How much time it takes again, you know to dress? How much time it takes again to walk from your room to hostel?

All that will automatically come planning. So that is why that disciplines. Unless you back-calculate all that I do not think it is possible. Or the moment you think that Ok, 15 minutes no problem, even if I am late then you do not have any planning. Absolutely you need not have any planning at all.

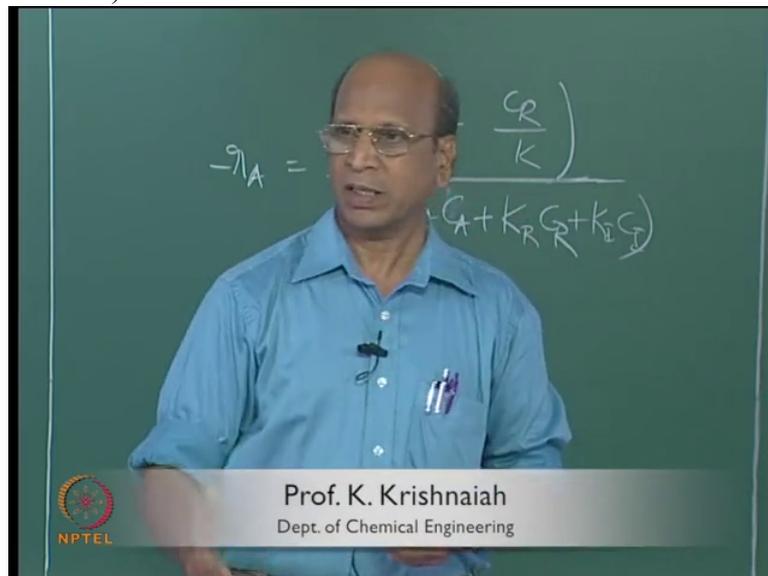
That is another very important thing. Try to be there just 5 minutes before. Whatever happens, even earthquake comes you have to jump that, you know crack and then you have to come and sit before breakfast. That is the kind of discipline when you have, then automatically you will reach very, very great heights.

Believe me, you really, I have seen many people who have that kind of discipline particularly with time. And those are the really great people I have seen. Somehow they would like to come 5 minutes before whatever they want, even if it is sixtieth year of sixty fifth year, or seventieth. And that only comes from our self-discipline.

So this learning and getting happiness when you are learning and this self-discipline and also this communication, not speaking in your mother tongue, I think mother tongue is there, you already know your mother tongue. I think at least try to learn some other language. And where this is a communicative language where you cannot escape that, no?

If you go for interview, can you escape that? If you are presenting your work before the committee for project or any problem or you know, many courses also have these presentations in the class. You have to take a paper and then present.

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So can you escape all this? Can you tell that Ok I will now tell in my mother tongue? You cannot tell that, it is not allowed.

Whatever is said and done, I think it is only English we are having in the academic institution. So that is why to master that, one simplest way is only to go for talking in that language all the time. Please try that. I know you will be comfortable in your own language but even if it is right or wrong try to speak. It does not matter.

I think slowly you will understand. Ok. So this is only as I told you, mind changing course, attitude changing so I hope at least few of you, I do not expect 100 percent of you will listen to me, Ok. Because I think always there is a virus anywhere. The only thing I have to see is that virus does not spoil the other people, right.

But you know, you will not but at least 50 percent, 60 percent of the people change, really I think as a teacher I have done my great duty then. So what we try to do in the next class is, as I told you I have to start from the beginning. What is the beginning? What do you think is beginning in C R E? What is C R E?

Ok, one step before that I go, I will ask a question, what is chemical engineering? It may be funny to ask you that question now but it is not really funny when I give that question what is chemical engineering and that could have been all red.

I have started with only what is chemical reaction there. If another question was there before that what is chemical engineering, how many of you can really define what is chemical engineering? I do not know how many of you really remember that.

So we do things like that without knowing what we are, we do things. And suppose you imagine that you know your brother or sister is asking, Ok what is chemical engineering? You will try to give some nice funny answer and then you forget. But will it not hurt you that really I am not able to explain to him what is chemical engineering.

Or even if your brother asks Ok what is chemical reaction? If you are not able to explain to them properly will it not hurt you? Definitely it will hurt. But normally what we do is the moment the question is asked it will, definitely we will get hurt but in one second or a fraction of second we feel bad and then try to forget that.

Ego. That egoism comes and dominates. He asked something, I told something. But really that pain that might got, I could not really understand, I could not really tell that what is the, no that poor fellow will believe whatever you say. If you say that chemical engineering means I will sit down and listen in the class, means he will believe.

That is the definition of chemical engineering for him. Ok, so he will listen, but I think he may go. He may be satisfied also, oh I will also become a chemical engineer because I can also go and sit in the class and listen to them that is all. Ok But it is not that.

Who is deceiving who? Are you deceiving him? Or before that we deceived ourselves. That is why I think all these things, before starting the class we need to talk. That is why tomorrow I will write some 5-6 questions and that answers will give you the overall picture of what is that you are doing in chemical engineering. And then the reactors will be automatically a part of that.

And now we focus on that particular point. Like you know Google Earth you have. So what do you focus, first of all? Google Earth. Then if you want to Chennai, zoom and then Chennai. Or I I T Madras or this classroom also. That is what what we do.

I will just give you what is overall view of what is chemical engineering, then zoom to finally C R E chemical reaction engineering, and in that again reactors because this is mainly, this course is mainly dealing with reactors and basics of chemical reaction engineering. Next course will be real applications, wonderful applications will come, all kinds of reactors, Ok.

So let us stop here. Ok, thank you for listening to me but please remember, tomorrow I will ask again some of these things what I told in the last class. Tomorrow you cannot clean your hard disk now. And then let me clean. By tomorrow morning I will be fresh. We have Thursday 10 o'clock or 11 o'clock?

(Professor – student conversation starts)

Student: 11

Professor: Thursday 11 o'clock we will again meet here then we will start what is chemical engineering and all, Ok? Thank you.

(Professor – student conversation ends)