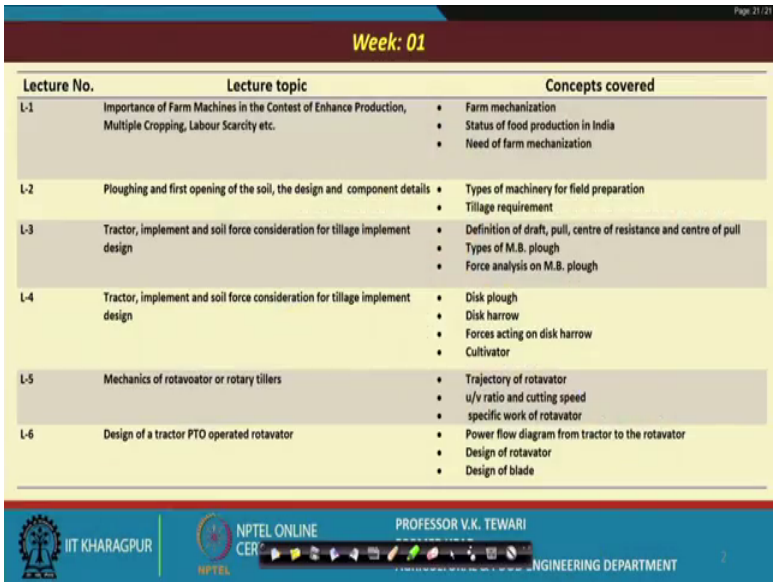
Farm Machinery
Prof. V. K. Tewari
Department of Agricultural and Food Engineering
Indian Institute of Technology, Kharagpur

Lecture – 60
Epilogue

Welcome the students to my last lecture, which is lecture number 60 and in fact, if you see I have designated as epilogue, you might have seen that at the end of every book there is a Epilogue chapter in which every detail of the whole book is given. In fact, this is what I am going to give you in this particular epilogue lecture number 60, see what I want to say that over the 12 weeks that I have covered various aspects and a farm machinery and conservation agriculture various aspects. So, I would like to take you through from the my first lecture to the 60th lecture and then we have given some sort of a other insight into different problems, which we should solve we have given answer to those problems, I think this will lecture will give you more insight into the whole book or you can see the lecture, which is right from lecture 1 to lecture 60th.

Let us go through these slides, which I have made for you and I am sure you will have several questions because, we have put in more of a numericals in this, but then we have also talked of what we discussed in every lecture. So, in short and I will go through these I hope you will be able to connect, what I am going to say here.

(Refer Slide Time: 01:36)



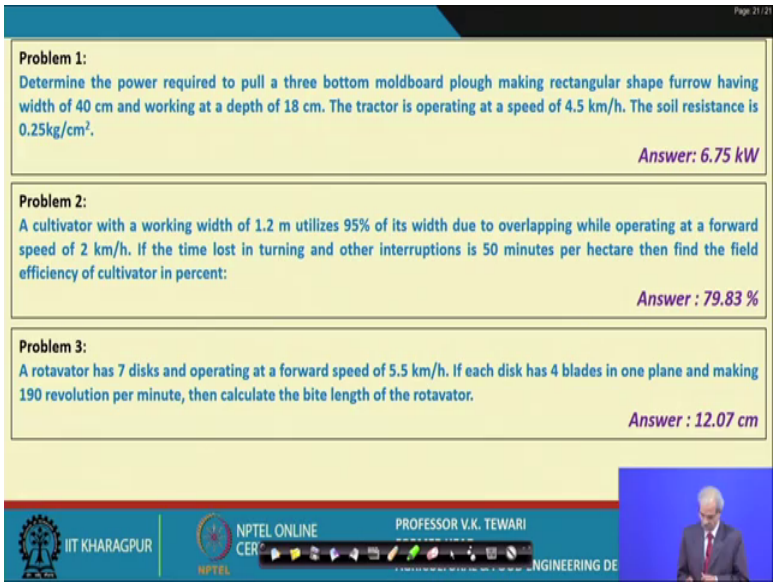
See week 1, in week 1 we had considered the farm mechanization, status of food production in India and need for farm mechanization, you would definitely like as an agricultural engineer, what is farm mechanization and why there is need for this? We have talked of the different machines for field preparation, we have talked of the different types of equipment available for preparation of the soil, what are the different parameters which we can try to design and consider when we are talking of the tillage operations.

What are the different aspects of this equipment? For example, disk plough, disk harrow. What are the forces acting on the soil? They are working in the soil, what is the trajectory of rotavoator? Which is one which is very very widely used nowadays? Similarly what are the UV ratio and cutting speed of this rotavoator?

The power flow diagram tractor to the rotavoator, how the power flows? We have also talked of this, we wanted to give you an idea about all the power is moving from the tractor to the implement then here, we have also talked of a design of rotavoator and design of the rotavoator blade, this is what was talked in week 1, through the various lectures, lecture 1 to lecture 6 in this.

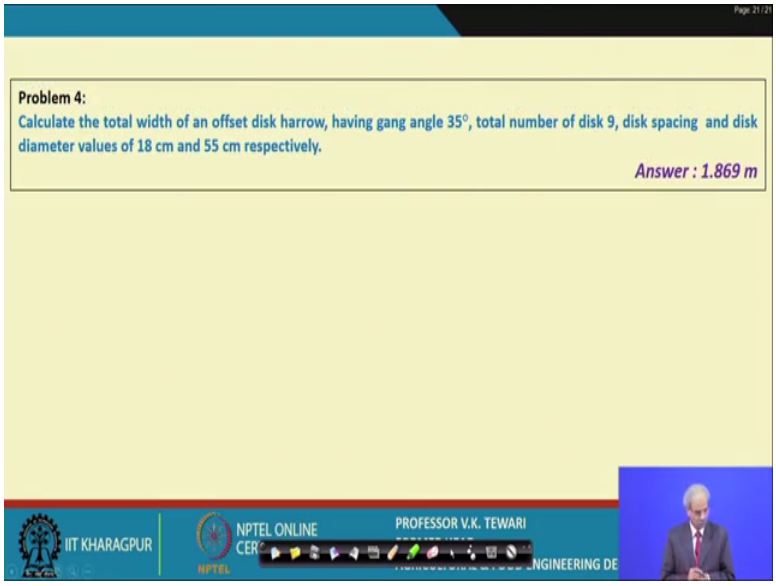
And we have given you various concepts these concepts will help you in understanding, the tillage concept and the need for mechanization and what are the parameters, which need to be considered if you want to redesign something, if you want to select something for a particular given farm size.

(Refer Slide Time: 03:15)



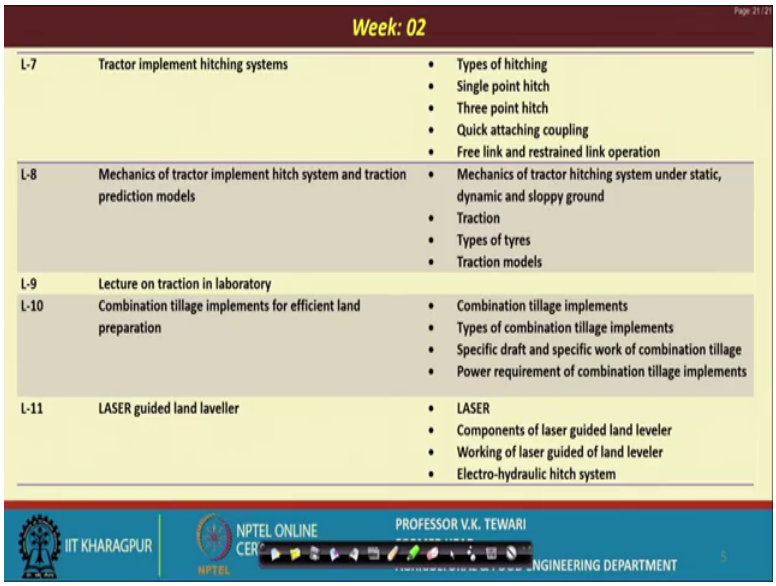
In this we have jotted down few problems for you can have a look at these problems. I am sure these problem, you will be in a position to understand and solve these problems we have given the answer of these problems all the 4 problems, which are given in this chapter particularly or for this particular week, we have picked up certain things for you. I hope you will be able to design more problems and then acquaint yourself very well with this particular week of the lectures, which we have considered.

(Refer Slide Time: 03:49)



4 problems so, as I said four problems have been done for this lecture in week 1.

(Refer Slide Time: 04:00)



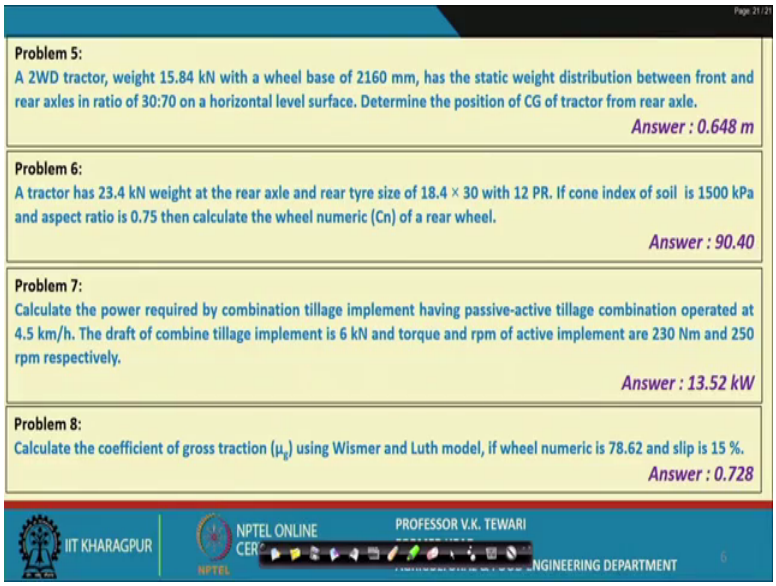
Now lecture week 2, this lecture week 2 was lecture 7 to lecture 11 and in this we have talked of different aspects of hitching, single point hitch, 3 point hitch, quick hitching couplings free link and restrained link operation mechanics of tractor hitching, we have talked of the dynamic.

The static dynamic and sloping ground, what happens when the tractor is there? What is traction? Although you will find that people do not include this chapter in the farm machinery book, but I think it is very essential, that traction is taken care of because, implement is the one which creates traction when it is there in connection with the soil. The types of tyres then tractor, what are the different traction models?

What are the combination tillage? what are the types of combination tillage, which we have? What is specific drop? What is specific work for combination tillage? Power requirement of given of the combination tillage implement. We have talked of all these, if you go back to the lectures of week 2, in these 7, 8, 9, 10, 11, we have talked of all these importance things.

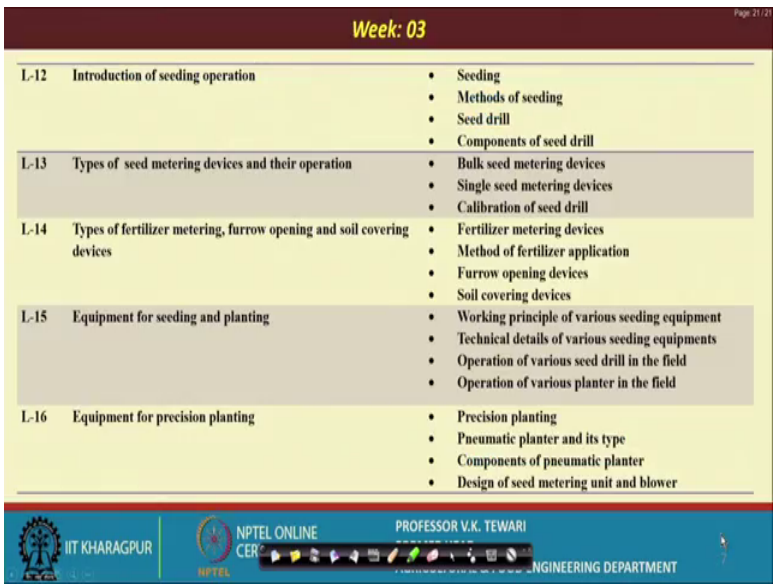
Because we have talked of the laser, we have talked of a laser guided line labeler, which has become a very important equipment, now for saving 20 to 30 percent of irrigation water. The components and details all these things have been talked of you had also talked of a hydraulic, electro hydraulic hitch system, which is slightly above and which talks of more of a automation in the tractor systems.

(Refer Slide Time: 05:43)



In this particular week then, we have also picked up few problems we have about 5, 6, 7, 8. 4 4 more problems are given and a the answers of all these problems are given. Well I am sorry, if there is any mistake in this, we hope that there would not be any mistake, but in advance I would like to say that if there is any mistake, it could be all inadvertent mistake or if at all there we will definitely like to rectify them as and when they come up, if you pick up and any problem that you face, I am sure you will come forward to ask us about the answers, how do we get these answers and what are the correct formula, to be used in all that.

(Refer Slide Time: 06:23)



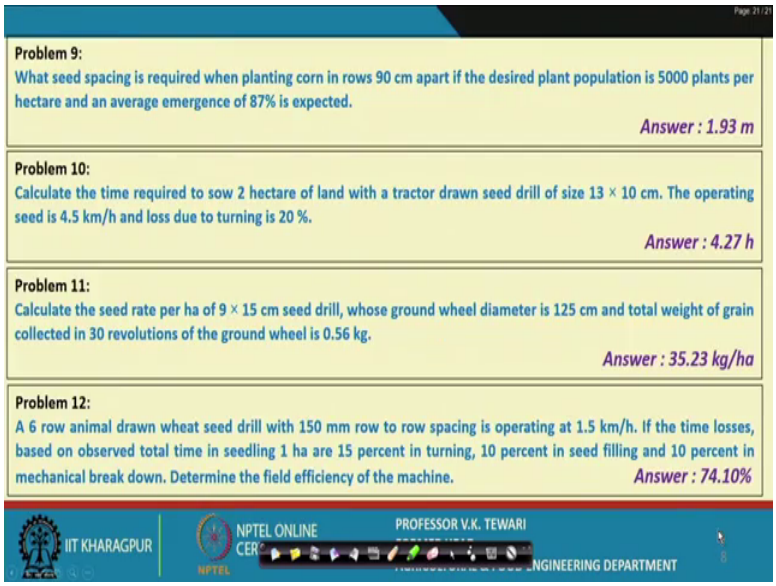
Now, we go to week 3. Now in third week, what do we get is? We have talked of the seeding equipment, we are talking about different methods of seeding, we are talking of the different types of seed drills, we are talking of the components of seed drill. So, the third week lecture 12, 13, 14, 15 and 16.

In these lectures, we have talked of the seeding equipment and the various fertilizer equipment and what are their details? For example, we are talking of the bulk seed metering devices, we are talking of the single seed metering devices, we are talking of calibration of these devices, we are talking of fertilizer metering devices metering systems, we are talking of the soil covering devices very important. You might have seen, we have also shown these things in the field operation of the equipment during the process.

Then we have talked of the operation of various seed drills, we have talked of the details of that in the field as well as in the in the laboratory then, we have talked of precision planting, we have talked of ok. This is very important thing we have talked of pneumatic planters and their details of pneumatic planters.

We have talked of what sort of design of seed metering unit and blowers are required, we have talked of. So, in this lecture we have talked of the seed and fertilizer equipment design, parameters, their nitty gritty details of a design and what are their advantages, disadvantages and how they should be utilized and for what crop and all that, we have talked of this in my third week.

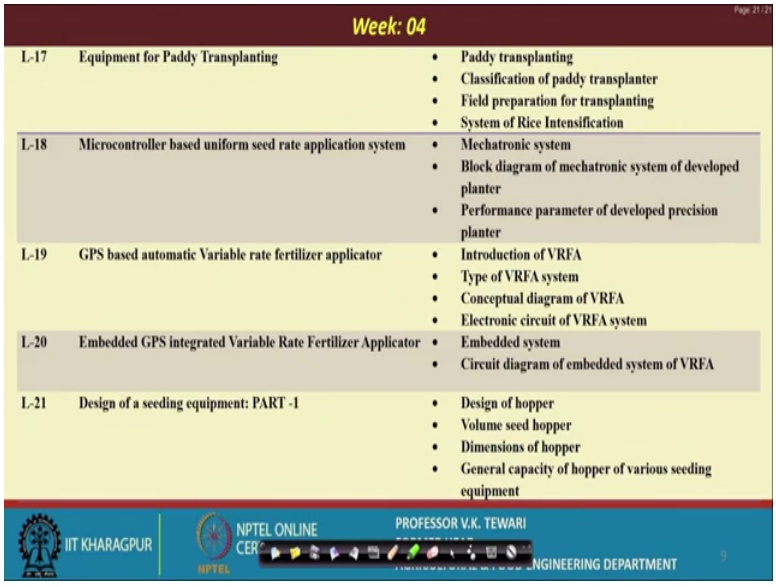
(Refer Slide Time: 08:00)



And then on the basis of these third week here, we have given 4 problem. Problem 9, 10, 11 and 12 again, 4 problems and we have solved this problem; these problems are very the straightforward problems, but then you must read the whole lecture and then only you will be able to answer there.

Because, we have tried to take the different aspects of the concepts, which we have developed and those things have been asked over here. So, until unless you go through the concepts, you will not be in a position to complete these problems.

(Refer Slide Time: 08:31)



Now, we go to week number 4, now in this week we are through lecture 17, 18, 19, 20 and 21. Now through these lectures, we have talked of paddy transplanting, we have talked of microcontroller based uniform seed rate application and we have talked of GPS based automatic variable rate fertilizer applicator, we have talk of embedded systems design of seeding equipment.

Now these, this particular lecture in a week, we have talked of certain advanced equipment, which you may not find in some books, where but, the research which has been done at IIT Kharagpur. We have talked of these for example, paddy transplanting, we have talked of the details of paddy transplanting classification, types of these equipment which are there.

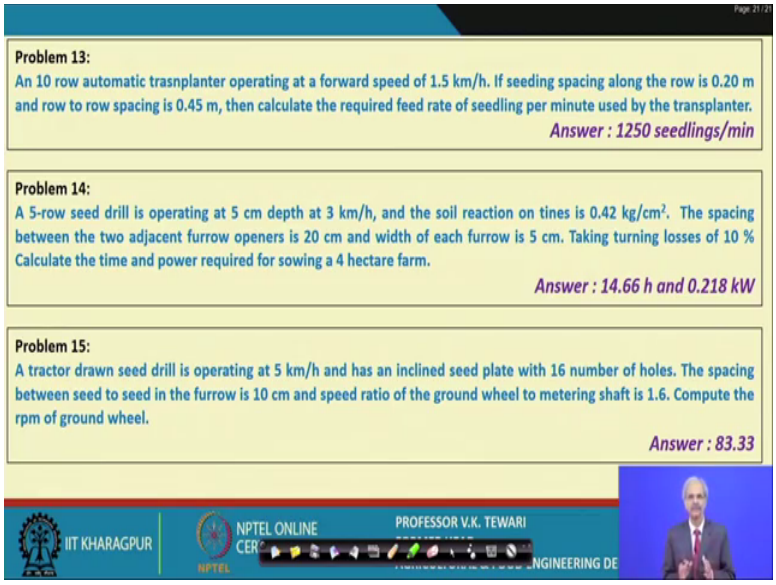
Then system, we have talked of SRI, which is being talked so much. So, system of rice intensification, this is being talked of so much in a drive dry land agriculture and we have talked of that also, which will help you understanding because, in 2018, a farm machinery engineer must be doing all the details of what were there in the past.

What has been over the last 20 30 years and what is going to happen in the next 20 30 years so, you should be so, the we have talked of all these and we have also talked of what is going to happen or what is likelihood and that is why, we have talked of the advance things, which we have done at IIT Kharagpur.

Those things have been inflated in this for example, the embedded system, the GPS and several micro controller, ultrasonic sensors, all these things have been used and those examples, we have given the principles, we have talked of the circuit diagrams, we have talked of. And we have for example we have infused in you the need for learning more and more beyond agriculture engineering. You need to learn more of electronics as well because, that is going to be utilized.

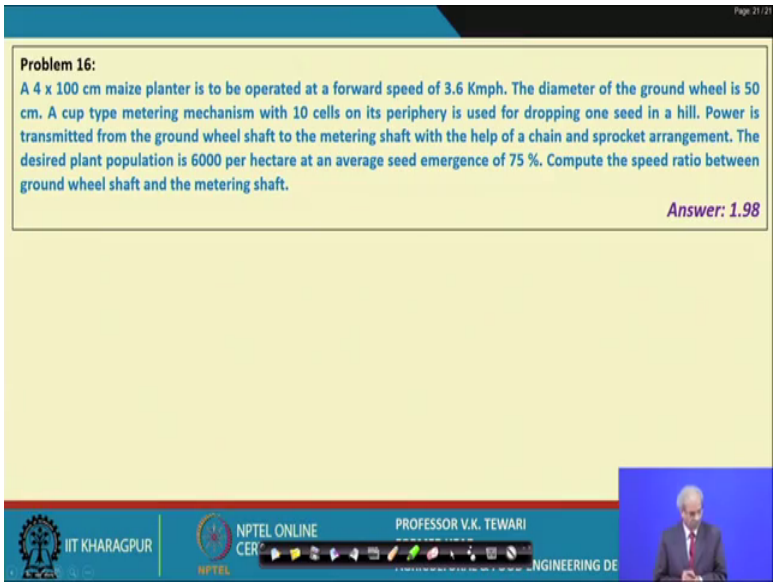
So, electronics and computer science also you must take some these lectures, which will help you in designing things, which will bring us equipment, which will be very you can say that, high graded and they are they will require a less cost as well as there will be easier to operate and they will take care of all the next agencies of the field.

(Refer Slide Time: 10:50)



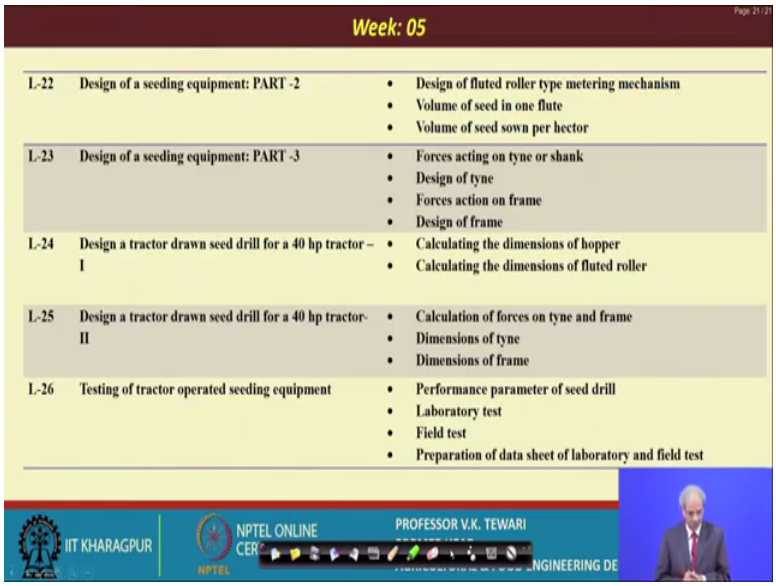
So, that is why these have been talked and then this also we have got about 3 problems here. 14, 13, 14 and 15 and these problems are all the basis of these lectures. So, you must go to the lectures and then only you will be in a position to answer these.

(Refer Slide Time: 11:06)



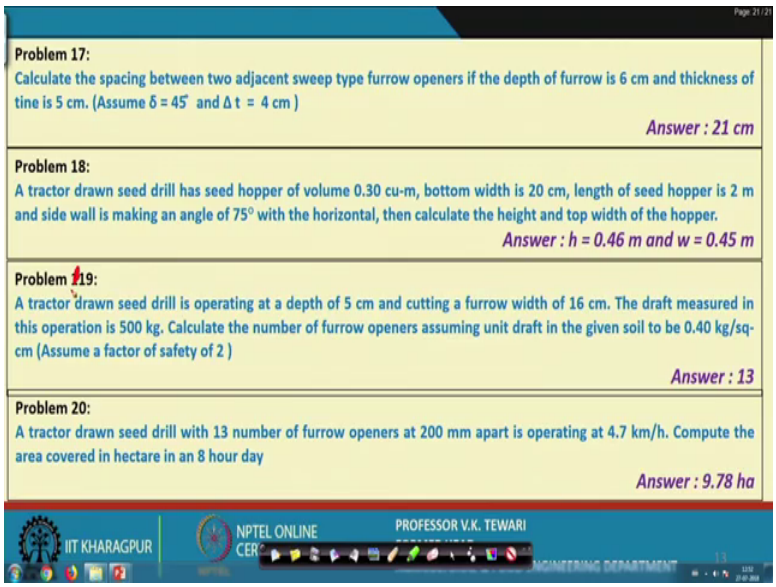
Then fourth problem is also given and the answer is given. So, with these 4 problems, the 3 is over and you if you go through that the aim of the numerical problems, I repeat is to go to let you know more details into the aspects of design and understanding the system.

(Refer Slide Time: 11:29)



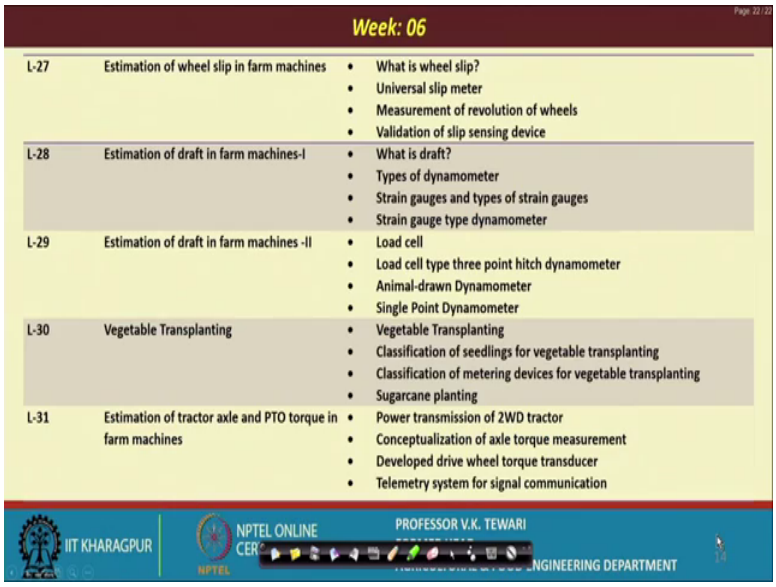
Week 5, well in this week, we had lecture number 22, 23, 24, 25 and 26 and in this lecture, we have talked of the various aspects of the seeding equipment and the design of the of a particular seed tractor drawn seed drill. We have also talked of testing of this equipment, this is very important and on the basis of all these then we have told you, what are the parameters, what are the nuances of details, which are required for forces acting for their calculations, dimensions all those things and that is why, on the basis of this, we have given you a set of problems 17, 18, 19. Sorry, there is a mistake here.

(Refer Slide Time: 12:12)



19 problem, 19 you put to 119 problem 19, 20 this problems are also given on that basis. So, you can you can solve these problems and understand more about, what we have talked in this particular week.

(Refer Slide Time: 12:43)

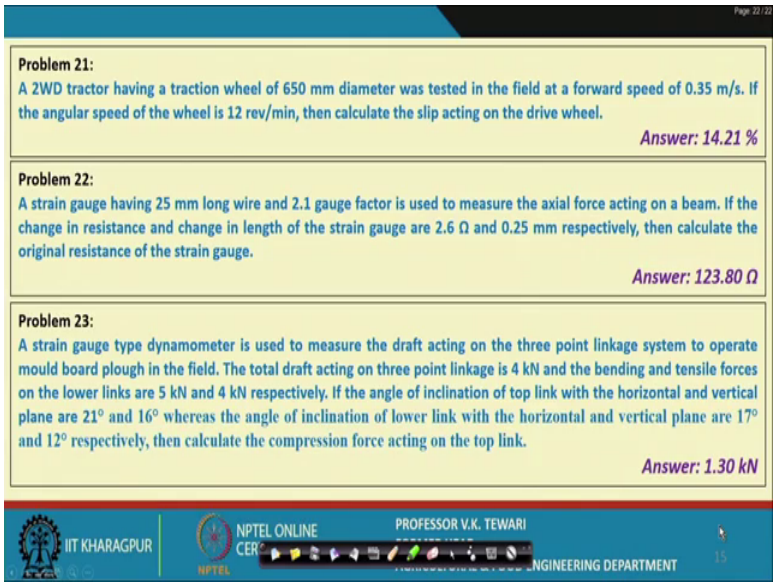


Week 6, well week 6 talks of the more details of the of a machines farm machines. The slip, the draft and the estimation of vegetable transplanting as well as estimation of tractor axle, PTO torque and several other things as they are certain things, which we have done at IIT Kharagpur and we wanted to explain to you.

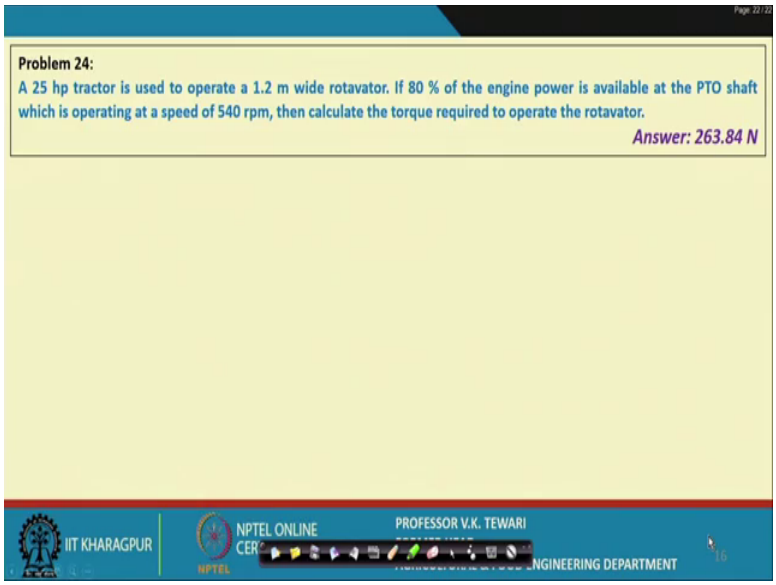
So, the lecture 27, 28, 29, 30, 31 talk in has been discussed in week 6, then this week, we have talked of all the details of for example, the wheel slip, universal slip, the validation of the slip sensing device, what is the load cell? How the load cells have been used in 3 point linkage which is dynamometer as we developed at IIT Kharagpur.

Then power transmission of a 2 wheel drive in tractor, conceptualization of an axle torque, which has been developed then the telemetry system for signal communication and all that, we have developed all those things and try to discuss this and on that basis we have, we have again jotted on few problems, which will help you to understand those things better answers are already given. So, you will be in a position to do and learn more with all the four problems which are given here.

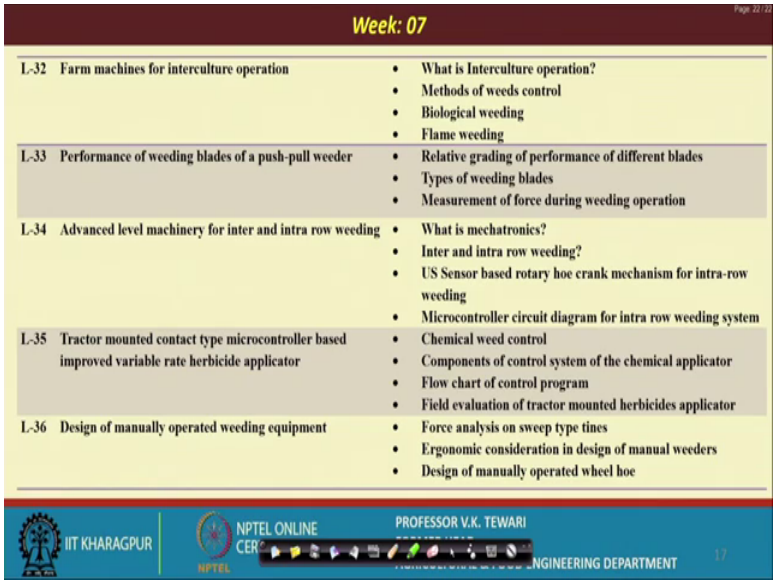
(Refer Slide Time: 13:49)



(Refer Slide Time: 14:01)



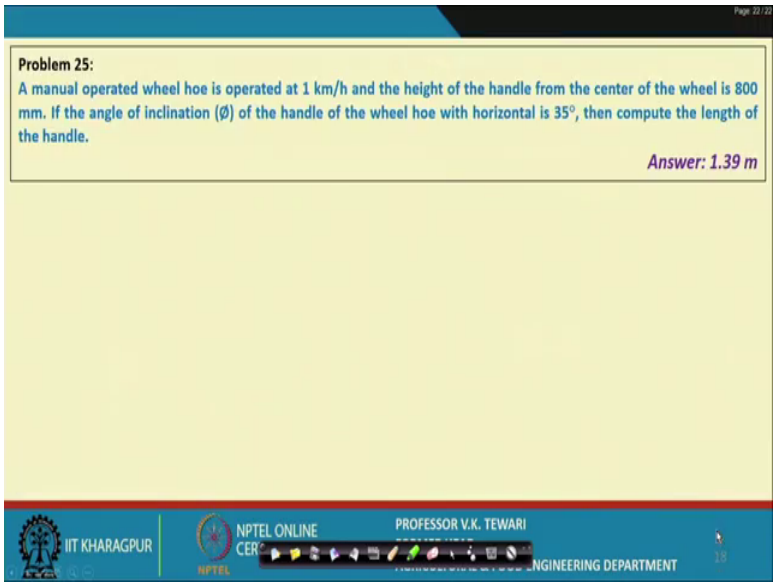
(Refer Slide Time: 14:04)



Week 7, now in week 7 we had lectures lecture number 32, 33, 34, 35, 36. Wherein, we have discussed the farm machines of inter-culture operation, weeding blades the different advances in may have intra, inter and intra, row weeding blades I mean equipment which are available then tractor mounted microcontroller based units, the herbicide applicator, the manual draw equipment, testing, etcetera.

So, several aspects have been discussed here for example, what is mechatronics? Then the, what is sensor based technology? How the chemicals will be utilized? We have also talked of ergonomics in design of a manual weeders, I mean we have talked of all these details, which are slightly different from what you will find in a normal farm machinery book.

(Refer Slide Time: 15:10)

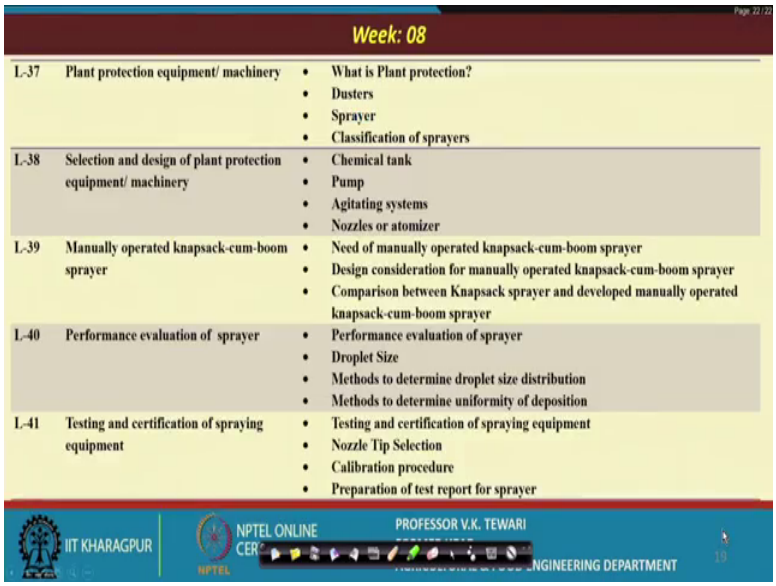


I want as I said earlier that in 2018 agricultural engineer must be equipped with all this information of what is happening today and what is likely to happen in future.

So, on this week then you will have another problem here, I think we have given you 1 problem in this case.

But then, I would request you to develop few more problems and then solve on your own and if you have done any problem, you can always ask me, when we will be on live someday then, you should ask the questions, you can also tell that this is the problem, I have designed and solved. We will be happy for that and we will appreciate that you have tried to learn something from what we have delivered.

(Refer Slide Time: 15:39)

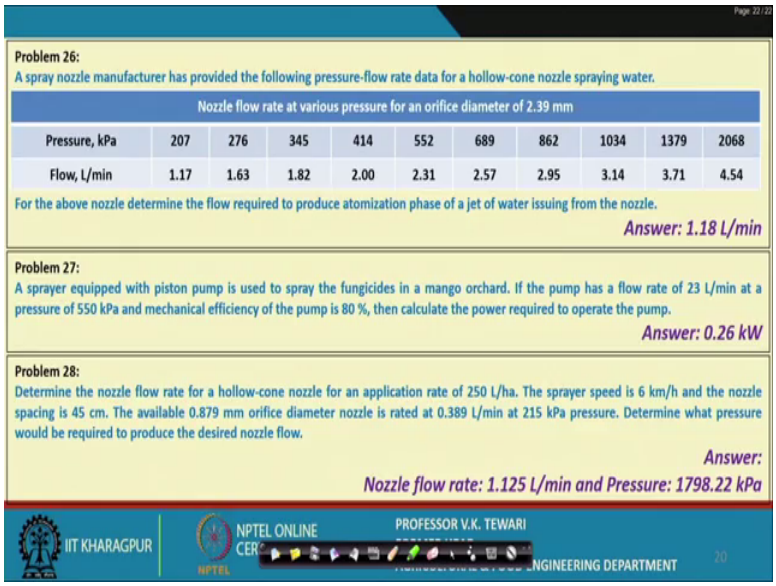


Week 8 actually, in week 8 we had lectures, lecture number 37, 38, 39, 40 and 41. In this, we have talked of the plant protection equipment, the selection and design of plant protection equipment, we have talked of the knapsack type, boom sprayer performance evolution of these testing and certification of the spraying equipment.

Now, as you will see that we have in these equipment, we have all talked of testing and certification as an agricultural engineer, you must be aware of all these things, because somebody will ask you to test and certify and you should be capable of doing that once, you understand the details, you know the procedure, you can record the data, you can report the data and then certify this, which includes then what is plant protection, duster, sprayers?

Then performance evaluation of sprayers and droplet size different types of nozzles etcetera all the details, which have been discussed in this particular week.

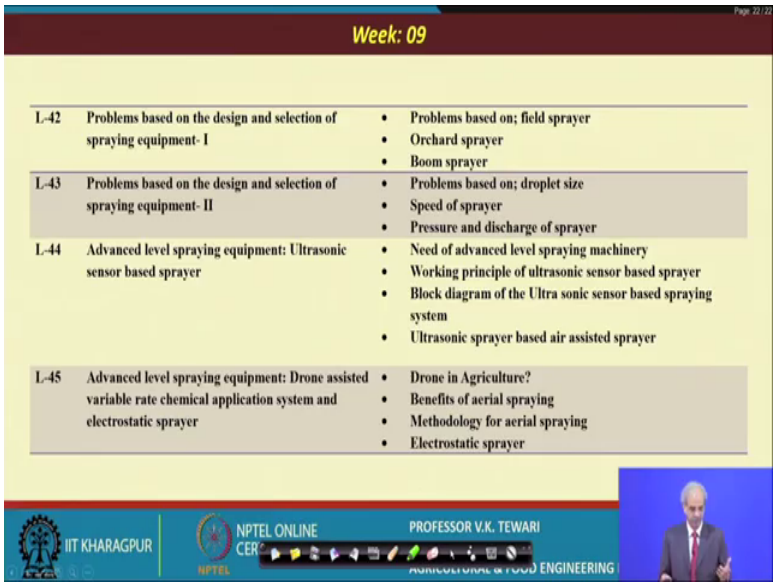
(Refer Slide Time: 16:44)



And on the basis of these then we have we have given problems these are some of the good problems that we have devised for you; you may not get these problems directly from any book.

We have tried to design those problems for you a certain portion definitely you may think that ok, but we have try to design new problems and we would request you to design further new problems out of the knowledge that you have gathered through this and check the answers which we have given. If you find any doubt in these answers we will definitely you can come back to us.

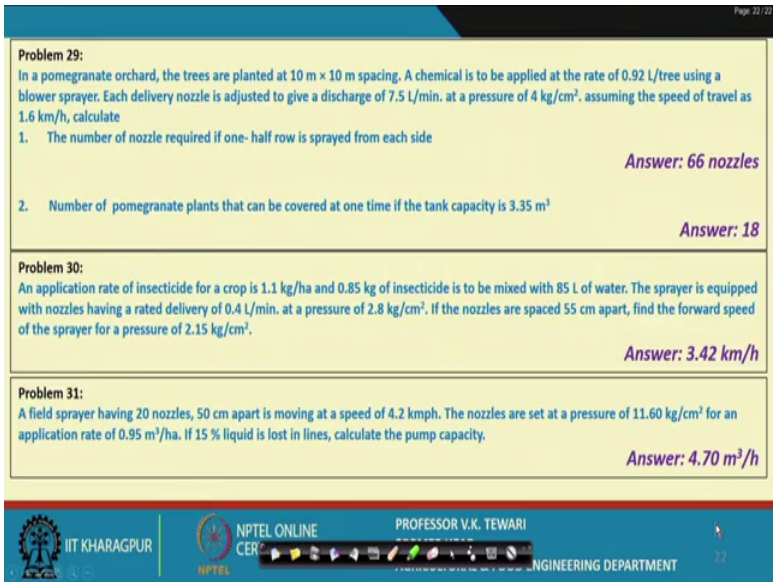
(Refer Slide Time: 17:11)



Lecture week 9, in this we had lecture number 42, 43, 44 and 45. In this, we have discussed about this, the design and selection of spraying equipment, problems associated with these selection then, advanced spraying equipment say like ultrasonic sensor based spraying, advanced spraying equipment like drone actually.

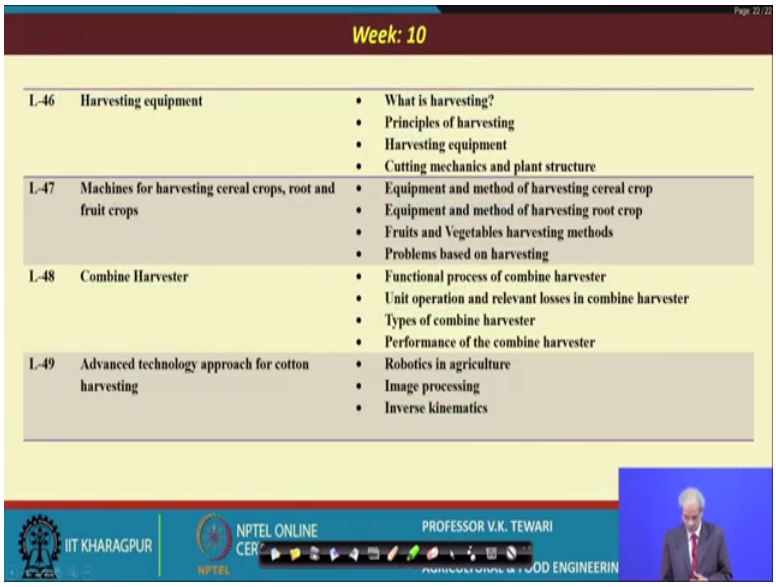
Now, robots are being used in many aspects for a long time, now in agriculture also it is possible to use them in various aspects and a lot of work is going on at several institutes in outside in the world. We are also doing it at IIT Kharagpur, which we have explained to you and shown you and we are talked of the working principle of all these and then try to explain to you, how you can utilize this knowledge. Definitely, while I have discussing, I had talked of that once you have to learned about learn or design something, you must have some information about image processing about automatic systems, about ultrasonic sensors and for that you have to go to electronics book or maybe to web a course on that which will help you in understand this.

(Refer Slide Time: 18:26)



So on this itself, we have designed a few problems 29, 30 and 31. So, these problems you can also use these problems for the answers and try to see whether, you understand more or not.

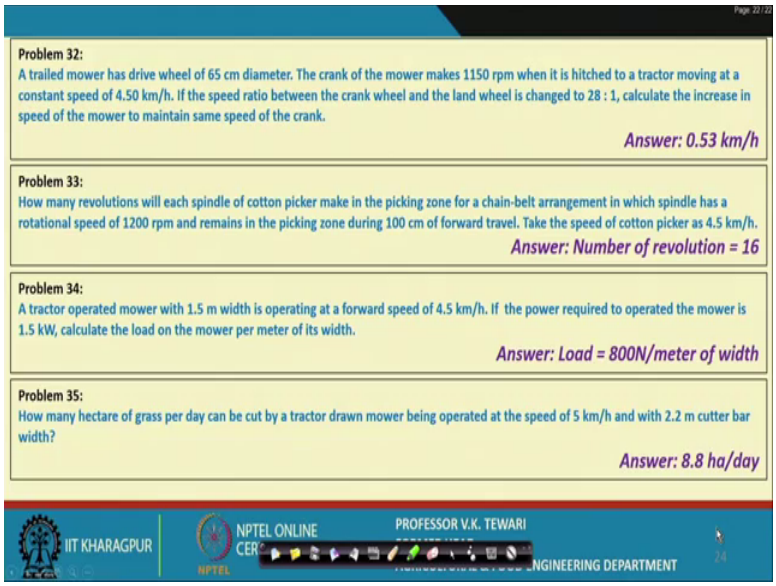
(Refer Slide Time: 18:39)



Week 10; well in this week, harvesting equipment, machines for harvesting for cereal crops, root crops and fruits crops then, combine harvester, which is very like used advanced technology for cotton harvesting, we had given as I said that, the roads are being used. So, advanced technology of robot utilization in cotton harvesting.

You must have seen when, I discussed about cotton harvesting, how difficult it is to do that and through this then, we have talked of the details of principles of harvesting, harvesting equipment, the mechanics of cutting. We have also talked of the fruit and vegetable harvesters, we have talked of robots and image processing.

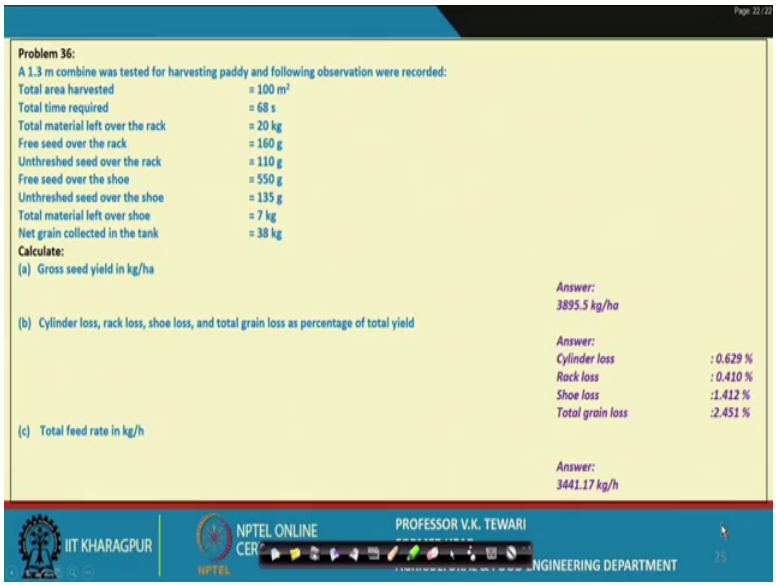
(Refer Slide Time: 19:33)



So, through this week 10, we have tried to give you certain advanced things which are there and we hope that, you will be able to understand this and on this week also we have framed certain problems 23, 32, 33, 34 and 35. Well these problems, some problems are short problems, some problems 3 4 line problems.

But remember that, everything has been thought of while giving a problem ok. So, that some concepts are used here. So, remember that you have while you can use the formula the concept must be clear to you.

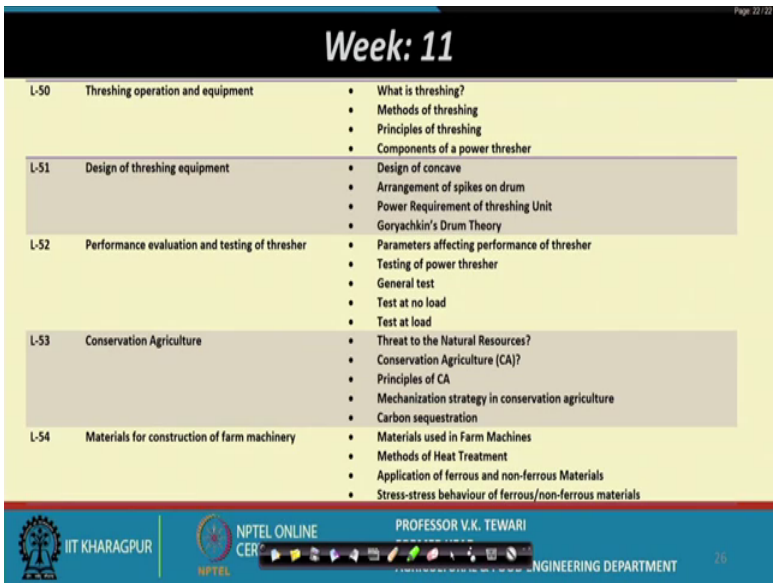
(Refer Slide Time: 19:58)



And check the answers which are given, you can see here that a big combined machine is given, where the tills are given and their answers are all given.

So, check the answers and if you find that there is some ambiguity in these answers, you may ask why, how we have got and how we are not you are not getting? So, you can always, you are most welcome to ask us those details.

(Refer Slide Time: 20:22)



Week 11, now in this week we have threshing operation and equipment through, lecture 50, 51, 52, 53 and 54. In this lecture week we have discuss, about the threshing operation

and equipment design of threshing equipment, performance evolution of evolution and testing of thresher, conservation agriculture, materials of construction of farm machinery. Now in this you will find see while, we have talked of the details of threshing and then performance, etcetera and testing, what is very important is as an agriculture engineer, you must know what is the material of construction of a particular component of a particular equipment.

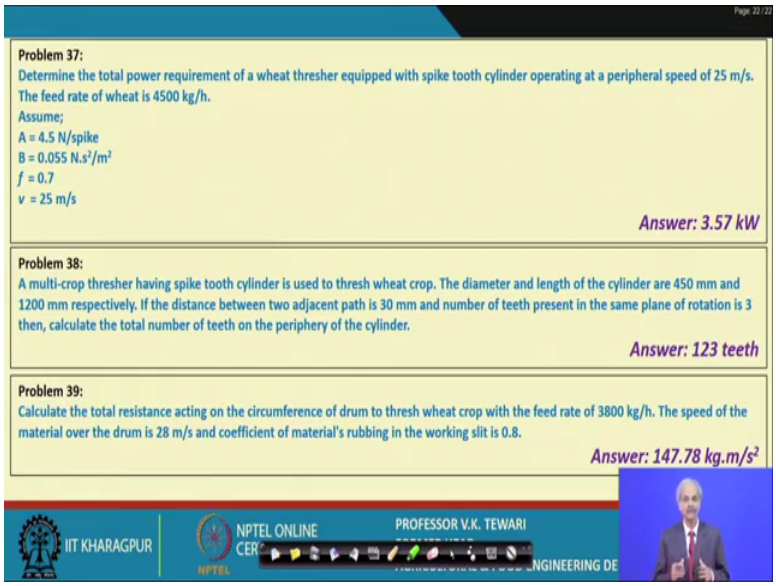
We know the equipment, we know it is operation, the principles, etcetera, but many a times the agriculture engineers, the students do not know about what is the type of material used and why it is used? What are the constituent of this? So, we thought that it is essential to have a lecture on that that is why, the lecture number 54 is very important; you must go through the materials of construction.

We have talked of what are the important parameters, which are there how the hardening takes place, why important hardening is important and what are the different strengths? How with the stress strain of the various ferrous and non ferrous materials changes, behaves those things, we have put in nutshell in this particular lecture.

I think this will make you a little bit of metallurgical engineer, when you go into details of that and as an engineer you must try to understand, what are these metals and why they are being used? But they will help you in choosing, which will be sometimes, when you want a lighter material, stronger material you should be able to use it.

When you want a stronger material, lighter material but, you can see that say lighter material and not heavier also both. So, depending on all sorts of things that, you want you should be in a position to choose this machine implements and components this has been discussed in week 11.

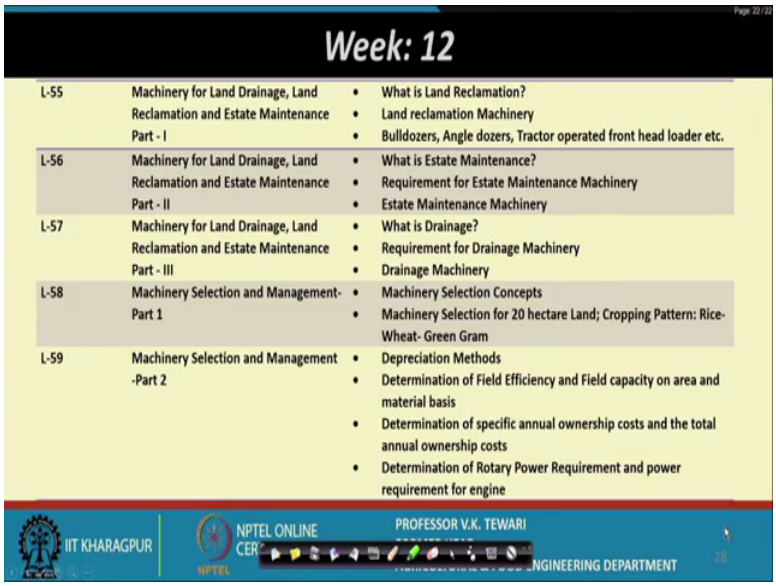
(Refer Slide Time: 22:31)



And on that also we have certain problems, we have framed certain problems on that to see more details into those which will help you once, you do these problems try to attempt these problems and see the answers, which we have given. Check whether they are correct or not, we are confident that they are correct, but check whether, you are getting the right concept or not.

Otherwise may be that you find that this with the answer, but we are wrong, but then the if you are not got the concept, you have not caught the concept, which we tried you may not be able to get it.

(Refer Slide Time: 23:03)



So week 12, in this week we have lecture 55, 56, 57, 58, 59 and in fact, this is the 60th lecture, you can see. So oh in this week, what we have discussed is very important things, we have for example, land reclamation machinery, land drainage, land reclamation and estate maintenance machinery, very important.

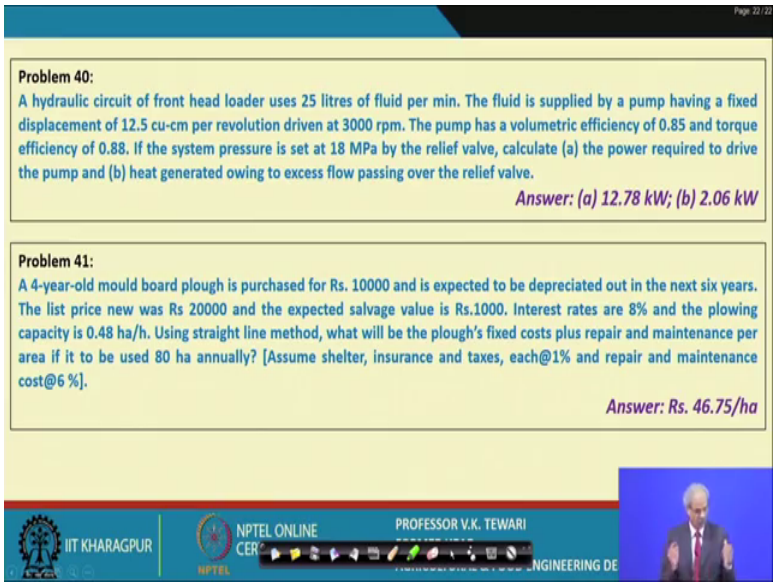
See you as an agriculture engineer; you must know that what are these machines? Why they are used? And if you are in charge of a land reclamation of a large area, which has not been used for long time then, you should be in a position to have these and you should be in a position to use the machines, you should be knowing these machines, where they are available? What is their capacity? How they work? What is their duty etcetera.

So, we have talked of the drainage machines, we have talked of the estate machinery, their selection and management. We have talked of all the details of what are the types of machines which are used bulldozers, (Refer Time: 24:06) the tractor operated front end loaders, we have talked of drainage machinery.

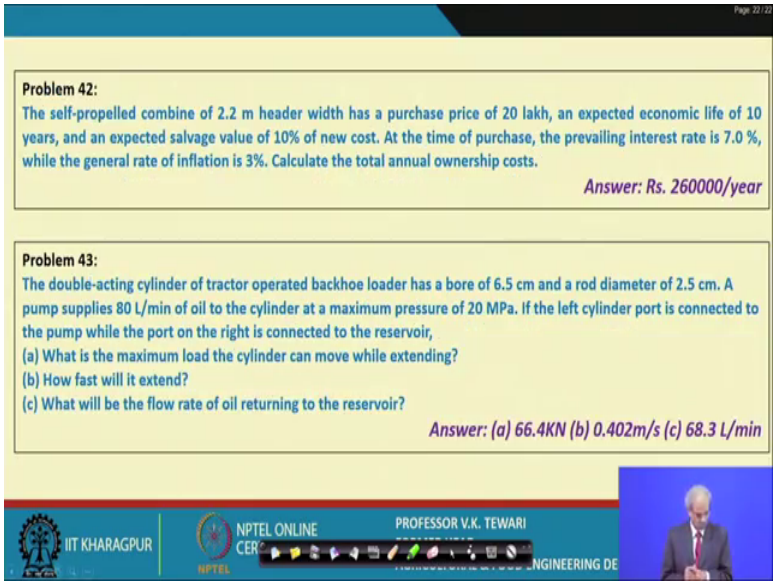
We have talked of the machinery selection and management. This is another things, we I think which we have discussed because, you until unless you know about the machinery selection and management. See though it is not complete for an agriculture engineer, you should be able to select machine, this while you can design, you should be able to select machine for a farm size say, 20 hectare we have discussed in one of the lectures.

But if you are asked him for a 10,000 hectare area, what are the crops to be grown? What equipment to be taken? What sort of management to be taken? What crop rotations and what cropping intensity, you will do? I think these are things which you have to have and you must do. So for that, we wanted to have this particular lecture number 59 and I am sure this will help you in understanding and selecting a machine and you will make you a complete agriculture engineer.

(Refer Slide Time: 25:08)



(Refer Slide Time: 25:13)



On the basis of this also, we have jotted down few problems 40, 41 and I think 42, 43. So, you have seen about 4 problems on this as well.

So, we have corrected these problems and thrown to you. So, that you can solve these problems and have these answers. Well I think, this way I conclude my lecture, but I would like to. In fact, mention importance about the people, who have helped me particularly in the field equipment testing and field data which was there. So, I would like that, they should be also acknowledged along with my lectures because, they had been right from the beginning. So, let us see who are the people whom I have acknowledge and I would like that they should be mentioned in my whole 12 weeks lectures.

They are here, we would like to introduce my fellow workers, who have helped us in the field task and the field testing of the various machines, we have seen you know that these 2 are our teaching assistants, Mister Pratik Srivasthav and Mister Chanchal Gupta. Then, we have other staff who have done other work, Mister Soman Perea then Nandkumar Sharma these people have been working here for a long time and they are very good in their own field then, Mister Raju then Mister Ranjan Devnath and Mister Naren Harendra Sharma and Shantham. So, these people have helped and I am very grateful to all of them that, they helped us in the field testing, that you have the students have seen over here.

Well I would like to say my gratefulness to NPTEL team, which has helped me through this 12 weeks, in several aspects and I am really grateful to them and I hope that they will be helping such people in future also.

The trouble that they have taken is unimaginable. In fact, I have seen them working over right across the right morning to afternoon, late afternoon and night and also. So, I would wish that they should be, in fact, acknowledged and as one I would like to acknowledge them 1 by 1, I request them that they when I call the names I they should be shown along with me.

So first of all, I will call Mister A V Ram Ramachar lu which whom we call popularly Mister Ramu. So he is one, who has helped me and I am very grateful to him, thank you very much.

Thank you sir.

Now I will request Sridevis Prasad Ji, who has been always nice to me and always help me in the in this lectures, through all the 12 weeks and I am grateful to him. So, I wish that he should be also acknowledged thank you. Mister Debapriya Chakravarthy, who has been a very nice gentleman and always ready to help any time that I have required during this period so, I thank him for the help that he has given to me thank you very much. Then the Rithi Roopa Das, she had been a very nice and very soft spoken lady and she has helped me in each lectures and the help that she has given, I can never forget.

So, thank you very much Rithu and hope you all the best in life. Mister Saurabh Bhattacharya, this gentleman is a very person, who has a no nonsense person, but always less talks and always of action. I liked him whenever he when I had problem with my microphone and all that so, he would like to put it properly.

He has done this for the over 12 weeks, I am grateful to him and thank you very much. Mister Sushanth Mahapatra actually very nice gentleman, you can see this his beard. So, I am very much fascinated with the his beard and right from the day 1, I came here he has been there and always helped me, I would like to acknowledge him and I would like to thank him for all the help that he has given to me, thank you very much ok. Ajay Mallik a person whom you can never forget, always he will come with the 5 minutes left.

So, before the lecture ends, he will remind us. So, I am grateful to him and I wish that such people should not be ignored, I am grateful to you thank you very much.

Thank you sir.

I conclude my lectures and I thank again the whole NPTEL team for this farm machinery lecture. I should not forget mister S S Das, person who actually introduced me to NPTEL about 2 years back at Madras airport, when I was sitting he told me that, sir we had conferred some meeting here, because that NPTEL course sponsored by MHRD is going to is going on and IIT Madras is the one which, who is looking after.

So, why did not you give a course on in this, I will give you details please mister S S Das, Mister Das and I would like to be say that, I am grateful to him that ultimately, he caught me this summer and I am in a position to do this course of farm machinery

because, he stressed that sir, this is only department in the IIT system of agricultural engineering. So, you must give a course of farm machinery, which is in high demand. So, I am thankful to you Mister Das and I wish that you have a nice life and best of all thank you whole team of NPTEL for this course.

Thank you.