

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)

Week: 01		
Lecture No.	Lecture topic	Concepts covered
L-1	Importance of Farm Machines in the Contest of Enhance Production, Multiple Cropping, Labour Scarcity etc.	<ul style="list-style-type: none"> • Farm mechanization • Status of food production in India • Need of farm mechanization
L-2	Ploughing and first opening of the soil, the design and component details	<ul style="list-style-type: none"> • Types of machinery for field preparation • Tillage requirement
L-3	Tractor, implement and soil force consideration for tillage implement design	<ul style="list-style-type: none"> • Definition of draft, pull, centre of resistance and centre of pull • Types of M.B. plough • Force analysis on M.B. plough
L-4	Tractor, implement and soil force consideration for tillage implement design	<ul style="list-style-type: none"> • Disk plough • Disk harrow • Forces acting on disk harrow • Cultivator
L-5	Mechanics of rotavator or rotary tillers	<ul style="list-style-type: none"> • Trajectory of rotavator • u/v ratio and cutting speed • specific work of rotavator
L-6	Design of a tractor PTO operated rotavator	<ul style="list-style-type: none"> • Power flow diagram from tractor to the rotavator • Design of rotavator • Design of blade

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 rotavator? Which is one which is very very widely used nowadays? Similarly what are the UV ratio and cutting speed of this rotavator?

The power flow diagram tractor to the rotavator, 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 rotavator and design of the rotavator 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)

Page 21/21

Problem 1:
Determine the power required to pull a three bottom moldboard plough making rectangular shape furrow having width of 40 cm and working at a depth of 18 cm. The tractor is operating at a speed of 4.5 km/h. The soil resistance is 0.25kg/cm².
Answer: 6.75 kW

Problem 2:
A cultivator with a working width of 1.2 m utilizes 95% of its width due to overlapping while operating at a forward speed of 2 km/h. If the time lost in turning and other interruptions is 50 minutes per hectare then find the field efficiency of cultivator in percent:
Answer : 79.83 %

Problem 3:
A rotavator has 7 disks and operating at a forward speed of 5.5 km/h. If each disk has 4 blades in one plane and making 190 revolution per minute, then calculate the bite length of the rotavator.
Answer : 12.07 cm

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DE

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)

Page 21/21

Problem 4:
Calculate the total width of an offset disk harrow, having gang angle 35°, total number of disk 9, disk spacing and disk diameter values of 18 cm and 55 cm respectively.
Answer : 1.869 m

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DE

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

(Refer Slide Time: 04:00)

Week: 02	
L-7	Tractor implement hitching systems <ul style="list-style-type: none">• Types of hitching• Single point hitch• Three point hitch• Quick attaching coupling• Free link and restrained link operation
L-8	Mechanics of tractor implement hitch system and traction prediction models <ul style="list-style-type: none">• Mechanics of tractor hitching system under static, dynamic and sloppy ground• Traction• Types of tyres• Traction models
L-9	Lecture on traction in laboratory
L-10	Combination tillage implements for efficient land preparation <ul style="list-style-type: none">• Combination tillage implements• Types of combination tillage implements• Specific draft and specific work of combination tillage• Power requirement of combination tillage implements
L-11	LASER guided land leveller <ul style="list-style-type: none">• LASER• Components of laser guided land leveller• Working of laser guided of land leveller• Electro-hydraulic hitch system

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

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)

Page 21/21

Problem 5:
A 2WD tractor, weight 15.84 kN with a wheel base of 2160 mm, has the static weight distribution between front and rear axles in ratio of 30:70 on a horizontal level surface. Determine the position of CG of tractor from rear axle.
Answer : 0.648 m

Problem 6:
A tractor has 23.4 kN weight at the rear axle and rear tyre size of 18.4 × 30 with 12 PR. If cone index of soil is 1500 kPa and aspect ratio is 0.75 then calculate the wheel numeric (Cn) of a rear wheel.
Answer : 90.40

Problem 7:
Calculate the power required by combination tillage implement having passive-active tillage combination operated at 4.5 km/h. The draft of combine tillage implement is 6 kN and torque and rpm of active implement are 230 Nm and 250 rpm respectively.
Answer : 13.52 kW

Problem 8:
Calculate the coefficient of gross traction (μ_g) using Wismer and Luth model, if wheel numeric is 78.62 and slip is 15 %.
Answer : 0.728

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

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)

Page 21/21

Week: 03

L-12	Introduction of seeding operation	<ul style="list-style-type: none">• Seeding• Methods of seeding• Seed drill• Components of seed drill
L-13	Types of seed metering devices and their operation	<ul style="list-style-type: none">• Bulk seed metering devices• Single seed metering devices• Calibration of seed drill
L-14	Types of fertilizer metering, furrow opening and soil covering devices	<ul style="list-style-type: none">• Fertilizer metering devices• Method of fertilizer application• Furrow opening devices• Soil covering devices
L-15	Equipment for seeding and planting	<ul style="list-style-type: none">• Working principle of various seeding equipment• Technical details of various seeding equipments• Operation of various seed drill in the field• Operation of various planter in the field
L-16	Equipment for precision planting	<ul style="list-style-type: none">• Precision planting• Pneumatic planter and its type• Components of pneumatic planter• Design of seed metering unit and blower

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

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)

Page 21/21

Problem 9:
What seed spacing is required when planting corn in rows 90 cm apart if the desired plant population is 5000 plants per hectare and an average emergence of 87% is expected.
Answer : 1.93 m

Problem 10:
Calculate the time required to sow 2 hectare of land with a tractor drawn seed drill of size 13×10 cm. The operating speed is 4.5 km/h and loss due to turning is 20 %.
Answer : 4.27 h

Problem 11:
Calculate the seed rate per ha of 9×15 cm seed drill, whose ground wheel diameter is 125 cm and total weight of grain collected in 30 revolutions of the ground wheel is 0.56 kg.
Answer : 35.23 kg/ha

Problem 12:
A 6 row animal drawn wheat seed drill with 150 mm row to row spacing is operating at 1.5 km/h. If the time losses, based on observed total time in seedling 1 ha are 15 percent in turning, 10 percent in seed filling and 10 percent in mechanical break down. Determine the field efficiency of the machine.
Answer : 74.10%

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

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)

Page 21/21

Week: 04

L-17	Equipment for Paddy Transplanting	<ul style="list-style-type: none">• Paddy transplanting• Classification of paddy transplanter• Field preparation for transplanting• System of Rice Intensification
L-18	Microcontroller based uniform seed rate application system	<ul style="list-style-type: none">• Mechatronic system• Block diagram of mechatronic system of developed planter• Performance parameter of developed precision planter
L-19	GPS based automatic Variable rate fertilizer applicator	<ul style="list-style-type: none">• Introduction of VRFA• Type of VRFA system• Conceptual diagram of VRFA• Electronic circuit of VRFA system
L-20	Embedded GPS integrated Variable Rate Fertilizer Applicator	<ul style="list-style-type: none">• Embedded system• Circuit diagram of embedded system of VRFA
L-21	Design of a seeding equipment: PART -1	<ul style="list-style-type: none">• Design of hopper• Volume seed hopper• Dimensions of hopper• General capacity of hopper of various seeding equipment

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

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)


Page 21/21

Problem 13:
An 10 row automatic transplanter operating at a forward speed of 1.5 km/h. If seeding spacing along the row is 0.20 m and row to row spacing is 0.45 m, then calculate the required feed rate of seedling per minute used by the transplanter.
Answer : 1250 seedlings/min

Problem 14:
A 5-row seed drill is operating at 5 cm depth at 3 km/h, and the soil reaction on tines is 0.42 kg/cm². The spacing between the two adjacent furrow openers is 20 cm and width of each furrow is 5 cm. Taking turning losses of 10 % Calculate the time and power required for sowing a 4 hectare farm.
Answer : 14.66 h and 0.218 kW

Problem 15:
A tractor drawn seed drill is operating at 5 km/h and has an inclined seed plate with 16 number of holes. The spacing between seed to seed in the furrow is 10 cm and speed ratio of the ground wheel to metering shaft is 1.6. Compute the rpm of ground wheel.
Answer : 83.33

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI
CER | ENGINEERING DE




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)

Page 21/21

Problem 16:
A 4 x 100 cm maize planter is to be operated at a forward speed of 3.6 Kmph. The diameter of the ground wheel is 50 cm. A cup type metering mechanism with 10 cells on its periphery is used for dropping one seed in a hill. Power is transmitted from the ground wheel shaft to the metering shaft with the help of a chain and sprocket arrangement. The desired plant population is 6000 per hectare at an average seed emergence of 75 %. Compute the speed ratio between ground wheel shaft and the metering shaft.
Answer: 1.98

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI
CER | ENGINEERING DE



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: 05

L-22	Design of a seeding equipment: PART -2	<ul style="list-style-type: none">• Design of fluted roller type metering mechanism• Volume of seed in one flute• Volume of seed sown per hecter
L-23	Design of a seeding equipment: PART -3	<ul style="list-style-type: none">• Forces acting on tyne or shank• Design of tyne• Forces action on frame• Design of frame
L-24	Design a tractor drawn seed drill for a 40 hp tractor - I	<ul style="list-style-type: none">• Calculating the dimensions of hopper• Calculating the dimensions of fluted roller
L-25	Design a tractor drawn seed drill for a 40 hp tractor- II	<ul style="list-style-type: none">• Calculation of forces on tyne and frame• Dimensions of tyne• Dimensions of frame
L-26	Testing of tractor operated seeding equipment	<ul style="list-style-type: none">• Performance parameter of seed drill• Laboratory test• Field test• Preparation of data sheet of laboratory and field test

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

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)

Problem 17:
Calculate the spacing between two adjacent sweep type furrow openers if the depth of furrow is 6 cm and thickness of tine is 5 cm. (Assume $\delta = 45^\circ$ and $\Delta t = 4$ cm)
Answer : 21 cm

Problem 18:
A tractor drawn seed drill has seed hopper of volume 0.30 cu-m, bottom width is 20 cm, length of seed hopper is 2 m and side wall is making an angle of 75° with the horizontal, then calculate the height and top width of the hopper.
Answer : h = 0.46 m and w = 0.45 m

Problem 19:
A tractor drawn seed drill is operating at a depth of 5 cm and cutting a furrow width of 16 cm. The draft measured in this operation is 500 kg. Calculate the number of furrow openers assuming unit draft in the given soil to be 0.40 kg/sq-cm (Assume a factor of safety of 2)
Answer : 13

Problem 20:
A tractor drawn seed drill with 13 number of furrow openers at 200 mm apart is operating at 4.7 km/h. Compute the area covered in hectare in an 8 hour day
Answer : 9.78 ha

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

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: 06	
L-27	Estimation of wheel slip in farm machines <ul style="list-style-type: none"> • What is wheel slip? • Universal slip meter • Measurement of revolution of wheels • Validation of slip sensing device
L-28	Estimation of draft in farm machines-I <ul style="list-style-type: none"> • What is draft? • Types of dynamometer • Strain gauges and types of strain gauges • Strain gauge type dynamometer
L-29	Estimation of draft in farm machines -II <ul style="list-style-type: none"> • Load cell • Load cell type three point hitch dynamometer • Animal-drawn Dynamometer • Single Point Dynamometer
L-30	Vegetable Transplanting <ul style="list-style-type: none"> • Vegetable Transplanting • Classification of seedlings for vegetable transplanting • Classification of metering devices for vegetable transplanting • Sugarcane planting
L-31	Estimation of tractor axle and PTO torque in farm machines <ul style="list-style-type: none"> • Power transmission of 2WD tractor • Conceptualization of axle torque measurement • Developed drive wheel torque transducer • Telemetry system for signal communication

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)

Page 27/22

Problem 21:
A 2WD tractor having a traction wheel of 650 mm diameter was tested in the field at a forward speed of 0.35 m/s. If the angular speed of the wheel is 12 rev/min, then calculate the slip acting on the drive wheel.
Answer: 14.21 %

Problem 22:
A strain gauge having 25 mm long wire and 2.1 gauge factor is used to measure the axial force acting on a beam. If the change in resistance and change in length of the strain gauge are 2.6 Ω and 0.25 mm respectively, then calculate the original resistance of the strain gauge.
Answer: 123.80 Ω

Problem 23:
A strain gauge type dynamometer is used to measure the draft acting on the three point linkage system to operate mould board plough in the field. The total draft acting on three point linkage is 4 kN and the bending and tensile forces on the lower links are 5 kN and 4 kN respectively. If the angle of inclination of top link with the horizontal and vertical plane are 21° and 16° whereas the angle of inclination of lower link with the horizontal and vertical plane are 17° and 12° respectively, then calculate the compression force acting on the top link.
Answer: 1.30 kN

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

(Refer Slide Time: 14:01)

Page 27/22

Problem 24:
A 25 hp tractor is used to operate a 1.2 m wide rotavator. If 80 % of the engine power is available at the PTO shaft which is operating at a speed of 540 rpm, then calculate the torque required to operate the rotavator.
Answer: 263.84 N



IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

(Refer Slide Time: 14:04)

Page 22/22

Week: 07

L-32 Farm machines for interculture operation	<ul style="list-style-type: none"> • What is Interculture operation? • Methods of weeds control • Biological weeding • Flame weeding
L-33 Performance of weeding blades of a push-pull weeder	<ul style="list-style-type: none"> • Relative grading of performance of different blades • Types of weeding blades • Measurement of force during weeding operation
L-34 Advanced level machinery for inter and intra row weeding	<ul style="list-style-type: none"> • What is mechatronics? • Inter and intra row weeding? • US Sensor based rotary hoe crank mechanism for intra-row weeding • Microcontroller circuit diagram for intra row weeding system
L-35 Tractor mounted contact type microcontroller based improved variable rate herbicide applicator	<ul style="list-style-type: none"> • Chemical weed control • Components of control system of the chemical applicator • Flow chart of control program • Field evaluation of tractor mounted herbicides applicator
L-36 Design of manually operated weeding equipment	<ul style="list-style-type: none"> • Force analysis on sweep type tines • Ergonomic consideration in design of manual weeders • Design of manually operated wheel hoe



 PROFESSOR V.K. TEWARI
 ENGINEERING DEPARTMENT

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)

Page 21/22

Problem 25:
A manual operated wheel hoe is operated at 1 km/h and the height of the handle from the center of the wheel is 800 mm. If the angle of inclination (θ) of the handle of the wheel hoe with horizontal is 35° , then compute the length of the handle.

Answer: 1.39 m

IIT KHARAGPUR | NPTEL ONLINE CENTER FOR ENGINEERING RESEARCH | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

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: 08		
L-37	Plant protection equipment/ machinery	<ul style="list-style-type: none">• What is Plant protection?• Dusters• Sprayer• Classification of sprayers
L-38	Selection and design of plant protection equipment/ machinery	<ul style="list-style-type: none">• Chemical tank• Pump• Agitating systems• Nozzles or atomizer
L-39	Manually operated knapsack-cum-boom sprayer	<ul style="list-style-type: none">• Need of manually operated knapsack-cum-boom sprayer• Design consideration for manually operated knapsack-cum-boom sprayer• Comparison between Knapsack sprayer and developed manually operated knapsack-cum-boom sprayer
L-40	Performance evaluation of sprayer	<ul style="list-style-type: none">• Performance evaluation of sprayer• Droplet Size• Methods to determine droplet size distribution• Methods to determine uniformity of deposition
L-41	Testing and certification of spraying equipment	<ul style="list-style-type: none">• Testing and certification of spraying equipment• Nozzle Tip Selection• Calibration procedure• Preparation of test report for sprayer

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)

Page 21/22

Problem 26:
A spray nozzle manufacturer has provided the following pressure-flow rate data for a hollow-cone nozzle spraying water.

Nozzle flow rate at various pressure for an orifice diameter of 2.39 mm										
Pressure, kPa	207	276	345	414	552	689	862	1034	1379	2068
Flow, L/min	1.17	1.63	1.82	2.00	2.31	2.57	2.95	3.14	3.71	4.54

For the above nozzle determine the flow required to produce atomization phase of a jet of water issuing from the nozzle.
Answer: 1.18 L/min

Problem 27:
A sprayer equipped with piston pump is used to spray the fungicides in a mango orchard. If the pump has a flow rate of 23 L/min at a pressure of 550 kPa and mechanical efficiency of the pump is 80 %, then calculate the power required to operate the pump.
Answer: 0.26 kW

Problem 28:
Determine the nozzle flow rate for a hollow-cone nozzle for an application rate of 250 L/ha. The sprayer speed is 6 km/h and the nozzle spacing is 45 cm. The available 0.879 mm orifice diameter nozzle is rated at 0.389 L/min at 215 kPa pressure. Determine what pressure would be required to produce the desired nozzle flow.
Answer:
Nozzle flow rate: 1.125 L/min and Pressure: 1798.22 kPa

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT | 20

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)

Week: 09

L-42	Problems based on the design and selection of spraying equipment- I	<ul style="list-style-type: none">• Problems based on; field sprayer• Orchard sprayer• Boom sprayer
L-43	Problems based on the design and selection of spraying equipment- II	<ul style="list-style-type: none">• Problems based on; droplet size• Speed of sprayer• Pressure and discharge of sprayer
L-44	Advanced level spraying equipment: Ultrasonic sensor based sprayer	<ul style="list-style-type: none">• Need of advanced level spraying machinery• Working principle of ultrasonic sensor based sprayer• Block diagram of the Ultra sonic sensor based spraying system• Ultrasonic sprayer based air assisted sprayer
L-45	Advanced level spraying equipment: Drone assisted variable rate chemical application system and electrostatic sprayer	<ul style="list-style-type: none">• Drone in Agriculture?• Benefits of aerial spraying• Methodology for aerial spraying• Electrostatic sprayer

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | AGRICULTURAL & FOOD ENGINEERING

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)

Page 21/22

Problem 29:
In a pomegranate orchard, the trees are planted at $10\text{ m} \times 10\text{ m}$ spacing. A chemical is to be applied at the rate of 0.92 L/tree using a blower sprayer. Each delivery nozzle is adjusted to give a discharge of 7.5 L/min . at a pressure of 4 kg/cm^2 . assuming the speed of travel as 1.6 km/h , calculate

1. The number of nozzle required if one- half row is sprayed from each side
Answer: 66 nozzles
2. Number of pomegranate plants that can be covered at one time if the tank capacity is 3.35 m^3
Answer: 18

Problem 30:
An application rate of insecticide for a crop is 1.1 kg/ha and 0.85 kg of insecticide is to be mixed with 85 L of water. The sprayer is equipped with nozzles having a rated delivery of 0.4 L/min . at a pressure of 2.8 kg/cm^2 . If the nozzles are spaced 55 cm apart, find the forward speed of the sprayer for a pressure of 2.15 kg/cm^2 .
Answer: 3.42 km/h

Problem 31:
A field sprayer having 20 nozzles, 50 cm apart is moving at a speed of 4.2 kmph . The nozzles are set at a pressure of 11.60 kg/cm^2 for an application rate of $0.95\text{ m}^3/\text{ha}$. If 15% liquid is lost in lines, calculate the pump capacity.
Answer: 4.70 m³/h

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

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)

Page 22/22

Week: 10

L-46	Harvesting equipment	<ul style="list-style-type: none">• What is harvesting?• Principles of harvesting• Harvesting equipment• Cutting mechanics and plant structure
L-47	Machines for harvesting cereal crops, root and fruit crops	<ul style="list-style-type: none">• Equipment and method of harvesting cereal crop• Equipment and method of harvesting root crop• Fruits and Vegetables harvesting methods• Problems based on harvesting
L-48	Combine Harvester	<ul style="list-style-type: none">• Functional process of combine harvester• Unit operation and relevant losses in combine harvester• Types of combine harvester• Performance of the combine harvester
L-49	Advanced technology approach for cotton harvesting	<ul style="list-style-type: none">• Robotics in agriculture• Image processing• Inverse kinematics

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | AGRICULTURE & FOOD ENGINEERING

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)

Page 23/22

Problem 32:
A trailed mower has drive wheel of 65 cm diameter. The crank of the mower makes 1150 rpm when it is hitched to a tractor moving at a constant speed of 4.50 km/h. If the speed ratio between the crank wheel and the land wheel is changed to 28 : 1, calculate the increase in speed of the mower to maintain same speed of the crank.
Answer: 0.53 km/h

Problem 33:
How many revolutions will each spindle of cotton picker make in the picking zone for a chain-belt arrangement in which spindle has a rotational speed of 1200 rpm and remains in the picking zone during 100 cm of forward travel. Take the speed of cotton picker as 4.5 km/h.
Answer: Number of revolution = 16

Problem 34:
A tractor operated mower with 1.5 m width is operating at a forward speed of 4.5 km/h. If the power required to operated the mower is 1.5 kW, calculate the load on the mower per meter of its width.
Answer: Load = 800N/meter of width

Problem 35:
How many hectare of grass per day can be cut by a tractor drawn mower being operated at the speed of 5 km/h and with 2.2 m cutter bar width?
Answer: 8.8 ha/day

IIT KHARAGPUR | NPTEL ONLINE CENTER | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

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)

Page 21/22

Problem 36:
A 1.3 m combine was tested for harvesting paddy and following observation were recorded:

Total area harvested	= 100 m ²
Total time required	= 68 s
Total material left over the rack	= 20 kg
Free seed over the rack	= 160 g
Unthreshed seed over the rack	= 110 g
Free seed over the shoe	= 550 g
Unthreshed seed over the shoe	= 135 g
Total material left over shoe	= 7 kg
Net grain collected in the tank	= 38 kg

Calculate:

(a) Gross seed yield in kg/ha

Answer:
3895.5 kg/ha

(b) Cylinder loss, rack loss, shoe loss, and total grain loss as percentage of total yield

Answer:

Cylinder loss	: 0.629 %
Rack loss	: 0.410 %
Shoe loss	: 1.412 %
Total grain loss	: 2.451 %

(c) Total feed rate in kg/h

Answer:
3441.17 kg/h

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

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)

Page 22/22

Week: 11

L-50	Threshing operation and equipment	<ul style="list-style-type: none">• What is threshing?• Methods of threshing• Principles of threshing• Components of a power thresher
L-51	Design of threshing equipment	<ul style="list-style-type: none">• Design of concave• Arrangement of spikes on drum• Power Requirement of threshing Unit• Goryachkin's Drum Theory
L-52	Performance evaluation and testing of thresher	<ul style="list-style-type: none">• Parameters affecting performance of thresher• Testing of power thresher• General test• Test at no load• Test at load
L-53	Conservation Agriculture	<ul style="list-style-type: none">• Threat to the Natural Resources?• Conservation Agriculture (CA)?• Principles of CA• Mechanization strategy in conservation agriculture• Carbon sequestration
L-54	Materials for construction of farm machinery	<ul style="list-style-type: none">• Materials used in Farm Machines• Methods of Heat Treatment• Application of ferrous and non-ferrous Materials• Stress-stress behaviour of ferrous/non-ferrous materials

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DEPARTMENT

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)

Page 21/22

Problem 37:
Determine the total power requirement of a wheat thresher equipped with spike tooth cylinder operating at a peripheral speed of 25 m/s. The feed rate of wheat is 4500 kg/h.
Assume;
 $A = 4.5 \text{ N/spike}$
 $B = 0.055 \text{ N.s}^2/\text{m}^2$
 $f = 0.7$
 $v = 25 \text{ m/s}$
Answer: 3.57 kW

Problem 38:
A multi-crop thresher having spike tooth cylinder is used to thresh wheat crop. The diameter and length of the cylinder are 450 mm and 1200 mm respectively. If the distance between two adjacent path is 30 mm and number of teeth present in the same plane of rotation is 3 then, calculate the total number of teeth on the periphery of the cylinder.
Answer: 123 teeth

Problem 39:
Calculate the total resistance acting on the circumference of drum to thresh wheat crop with the feed rate of 3800 kg/h. The speed of the material over the drum is 28 m/s and coefficient of material's rubbing in the working slit is 0.8.
Answer: 147.78 kg.m/s²

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DE

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)

Week: 12		
L-55	Machinery for Land Drainage, Land Reclamation and Estate Maintenance Part - I	<ul style="list-style-type: none">• What is Land Reclamation?• Land reclamation Machinery• Bulldozers, Angle dozers, Tractor operated front head loader etc.
L-56	Machinery for Land Drainage, Land Reclamation and Estate Maintenance Part - II	<ul style="list-style-type: none">• What is Estate Maintenance?• Requirement for Estate Maintenance Machinery• Estate Maintenance Machinery
L-57	Machinery for Land Drainage, Land Reclamation and Estate Maintenance Part - III	<ul style="list-style-type: none">• What is Drainage?• Requirement for Drainage Machinery• Drainage Machinery
L-58	Machinery Selection and Management- Part 1	<ul style="list-style-type: none">• Machinery Selection Concepts• Machinery Selection for 20 hectare Land; Cropping Pattern: Rice- Wheat- Green Gram
L-59	Machinery Selection and Management -Part 2	<ul style="list-style-type: none">• Depreciation Methods• Determination of Field Efficiency and Field capacity on area and material basis• Determination of specific annual ownership costs and the total annual ownership costs• Determination of Rotary Power Requirement and power requirement for engine

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)

Page 22/22

Problem 40:
 A hydraulic circuit of front head loader uses 25 litres of fluid per min. The fluid is supplied by a pump having a fixed displacement of 12.5 cu-cm per revolution driven at 3000 rpm. The pump has a volumetric efficiency of 0.85 and torque efficiency of 0.88. If the system pressure is set at 18 MPa by the relief valve, calculate (a) the power required to drive the pump and (b) heat generated owing to excess flow passing over the relief valve.
Answer: (a) 12.78 kW; (b) 2.06 kW

Problem 41:
 A 4-year-old mould board plough is purchased for Rs. 10000 and is expected to be depreciated out in the next six years. The list price new was Rs 20000 and the expected salvage value is Rs.1000. Interest rates are 8% and the plowing capacity is 0.48 ha/h. Using straight line method, what will be the plough's fixed costs plus repair and maintenance per area if it to be used 80 ha annually? [Assume shelter, insurance and taxes, each@1% and repair and maintenance cost@6 %].
Answer: Rs. 46.75/ha

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DE




(Refer Slide Time: 25:13)

Page 22/22

Problem 42:
 The self-propelled combine of 2.2 m header width has a purchase price of 20 lakh, an expected economic life of 10 years, and an expected salvage value of 10% of new cost. At the time of purchase, the prevailing interest rate is 7.0 %, while the general rate of inflation is 3%. Calculate the total annual ownership costs.
Answer: Rs. 260000/year

Problem 43:
 The double-acting cylinder of tractor operated backhoe loader has a bore of 6.5 cm and a rod diameter of 2.5 cm. A pump supplies 80 L/min of oil to the cylinder at a maximum pressure of 20 MPa. If the left cylinder port is connected to the pump while the port on the right is connected to the reservoir,
 (a) What is the maximum load the cylinder can move while extending?
 (b) How fast will it extend?
 (c) What will be the flow rate of oil returning to the reservoir?
Answer: (a) 66.4KN (b) 0.402m/s (c) 68.3 L/min

IIT KHARAGPUR | NPTEL ONLINE | PROFESSOR V.K. TEWARI | ENGINEERING DE



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.