Irrigation and Drainage
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Lecture – 35
Tutorial

Yeah; so, this is lecture number 35 on tutorial mostly on week 7 lectures. So, in this let us say.

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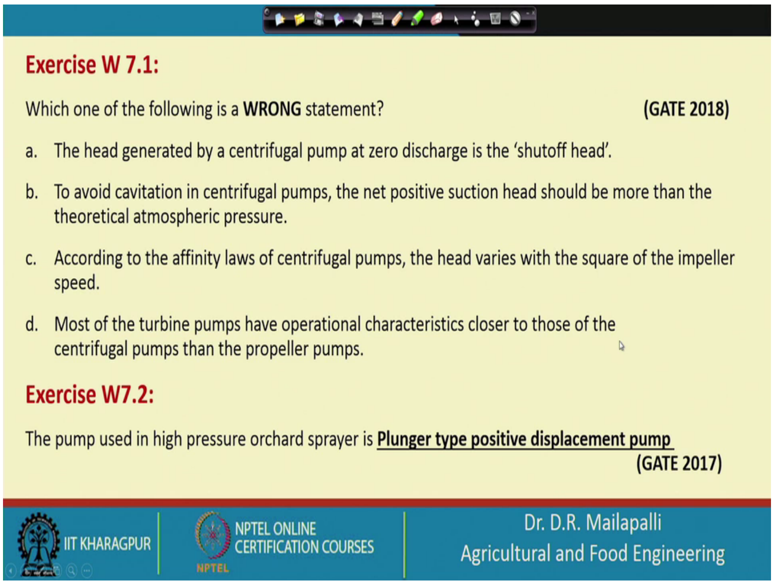

So, exercise number 1 if you see which of the following is wrong statement ok? So, let us see the head generated, the first one option is the head generated by centrifugal pump at zero discharge is shut off head. So, if you see this right; this is a discharge and head and this is a curve, if you remember the characteristic curve.

So, head generated the centrifugal pump at zero discharge, at this zero discharges whatever head you are seeing. So, this is called a shut off head right this is shut off head so; that means, when you close the delivery or when you close the discharge pipe completely and then on the when you see how maximum I mean you can achieve the head. So, this is shutoff head and the second is to avoid cavitation in centrifugal pumps. So, the net positive suction head should be more than the theoretical atmospheric pressure. So, this is one thing.

So, if the, in order to avoid cavitation in centrifugal pumps the net positive suction head which is the minimum head required to lift water right should be more than the theoretical atmosphere pressure. So, if it is more than if you more than what happened is the positive pressure right. So, nowhere is not going to suck anyway right; so, it should be negative pressure. So, probably this may be answer, but let us see there is the one; according to the affinity laws of centrifugal pumps the head varies with the square of the impeller speed. So, the head H which is varies with the impeller speed, a very scare of the impeller speed n square.

So, I think this is true because H by H 1 which is equal sorry the H on H 1 is equal to n by n 1 square right. So, this so, this is also true. So, this is true this is true and this has this is false and anyway let us see the most of the turban forms have operational characteristics close to those of the centrifugal pumps and propeller pumps. So, this is true; so, the only here the answer is b ok. So, because thus in order to lift water. So, the pressure should be less than atmospheric pressure. So, that you can you know sucked a water and this section exercise 7.2 the second the pump used to high pressure orchard sprayer is. So, definitely this is the plunger type if you observe there is a plunger, plunger type of positive displacement pumps is seal when a person who uses you know the sprayers.

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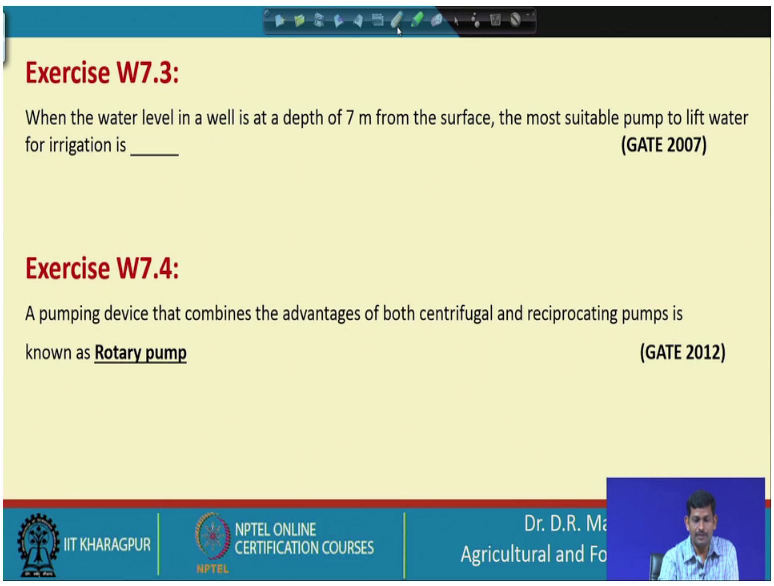

So, and the third one so, that is called when the water level in the well is at a depth 7 meter from the surface the most suitable pump to lift water for irrigation is. So, here there are several pumps low head pumps come coming, but mostly I mean will say the seven meter. So, the centrifugal pump can operate up to you know 7.5 meter, but still centrifugal pump can be the single stage centrifugal pump can be used.

And exercise 7.4 the pumping device that combines the advantage of both centrifugal and reciprocating pump is called the rotary pump, because the rotary pump has both centrifugal and the reciprocating action here. So, rotary in the sense you have gear pump or the vane pumps if you observe. So, I mean the cams, what are you are seeing the cams right. So, it has rotational as well as the centrifugal because the water which is flowing out.

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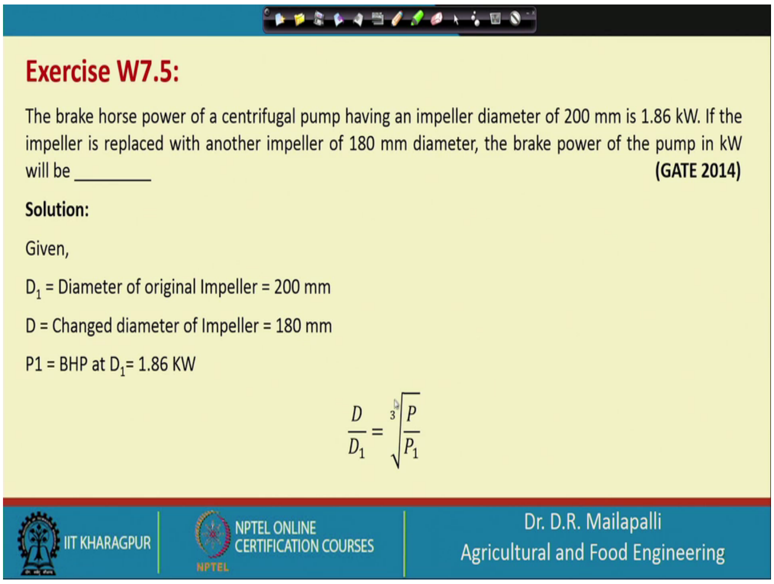

And then here there is an example the brake horse power of a centrifugal pump writes as a BHP of centrifugal pump having an impeller diameter from D is given he is a 1.86 kilowatts. So, this is horse p lets say P if the impeller is replaced with another impeller. So, that is let us say this is D 1 right the brake horse power of the pump will be. So, what is the P 1? So, this is simply from the affinity laws. So, affinity laws says like P by let us say like P by P 1 which is equal to d by d one right whole cube ok. So, you can use this equation find out the P 1 which is equal to right. So, P into D 1 by sorry D 1 by D over 3 there is anything ok, D 1 by the D whole power 1 by 3 yeah D 1 by the whole power 1 by 3.

Let us say. So, using that equation you get this simplification. So, then so, substituting the values.

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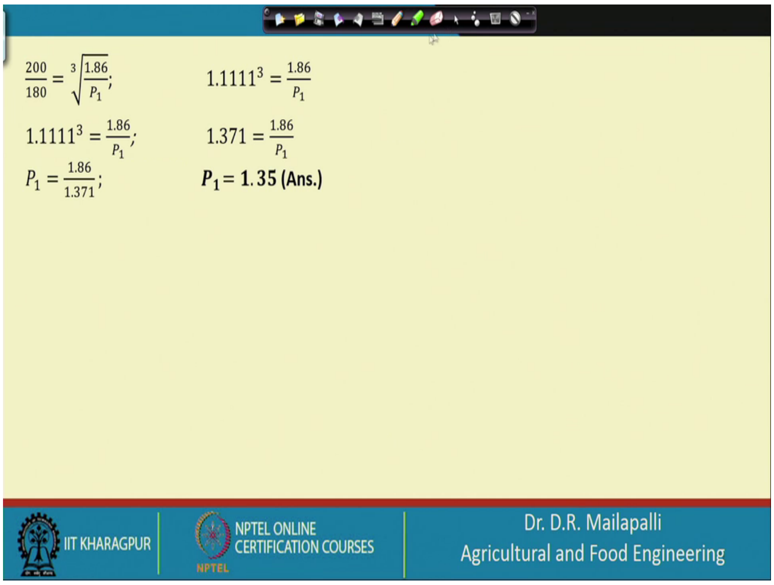

So, substitute those values here and you get the finally, the P 1 which is equal to 1.35 hp right or kilowatts, if that is a kilowatts its kilowatts.

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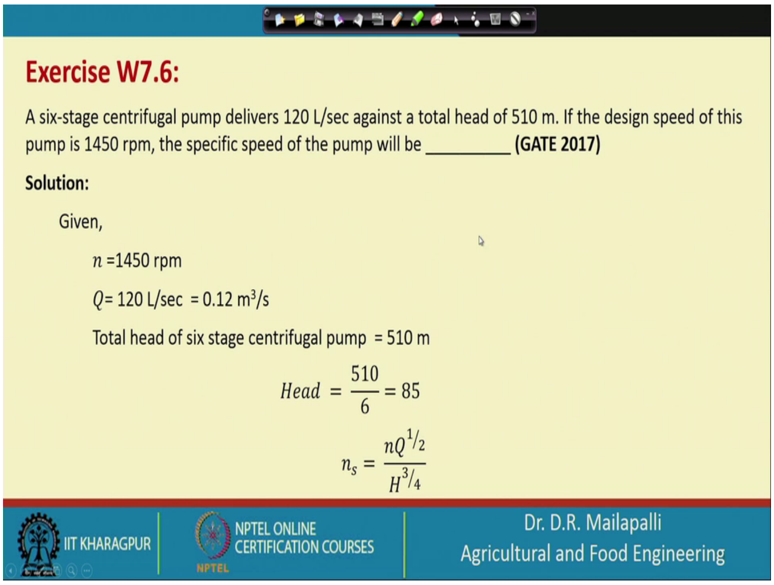

And the next is here it is says a 6 stage centrifugal pump which delivers 120 liter per second this is a cube against a total head this is head which is equal to 510 meters. If the design speed of this pump is this is n 1450 rpm the specific speed of the pump will be that is n s. So, n s is equal to n into Q power 1 by 2 into H power 3 by 4.

So, this equation if you use right so, all the values are given, but here the Q is in meter cube per second. So, we give to convert the Q 120 liter per second into meter cube per second that is 0.12 mete cube per second. N is 1450 rpm, the total head of six stage centrifugal pump 550, but since it is 6 stages let is consider one stage that is 560 by six stages that is 85 meter and substitute these values.

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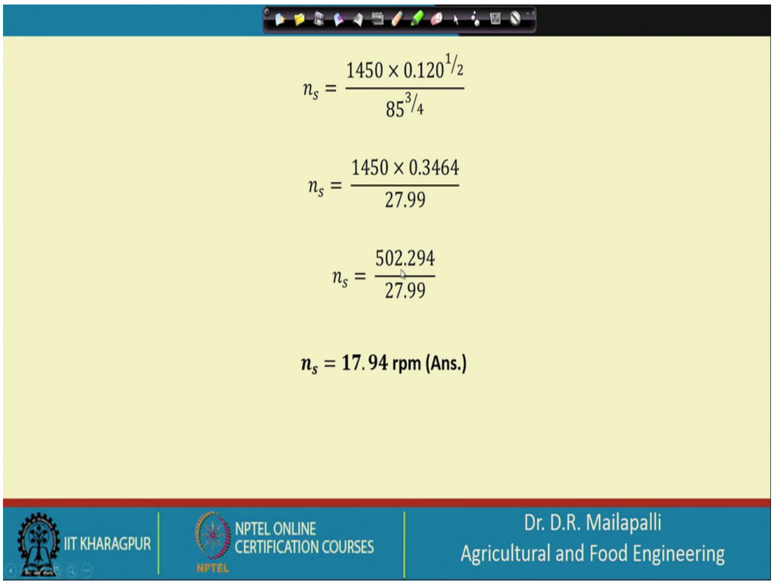

And if you can, if you substitute the values you get the n s as 17.94 rpm ok.

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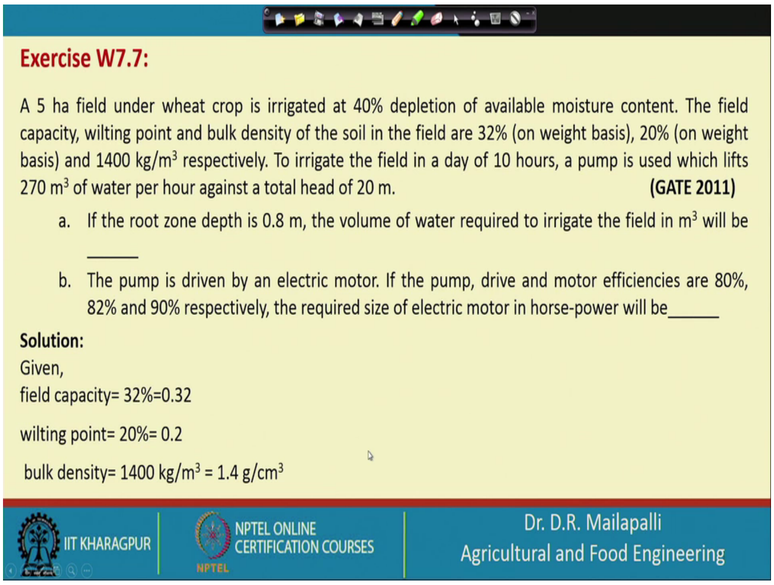

So, here this is another example, a 5 hectare field under wheat crop is irrigated at 40 percent depletion of available moisture content ok. So, the available moisture content is field capacity, moisture content minus wilting point moisture content. So, this will give the available moisture content, the field capacity and wilting point and bulk density of the soil in or 32 percent is a field capacity this is on weight basis and 20 percent wilting point again weight basis and 1400 kg per meter cube the bulk density. So, in order to convert the weight basis into volume basis you need to multiply the weight basis moisture content with bulk density. So, that you get volumetric moisture.

So, we have bulk density also in the problem. So, to irrigate the field in a day of 10 hours a pump is used which lifts 270 meter cube per water per hour against a total head of 20 meter ok. So, all the data is given the most of the data, if the root zone depth is 0.8 meter the volume of water required to irrigate the field will be. So, this is from the previous lecture we can find out.

So, knowing the available moisture content; available moisture content available water which is field capacity minus wilting point right, it multiplied by root zone depth. So, you get the available water, but we are expecting 40 percent depletion right, then 0.4 times of this available water. So, that depletion you need to replenish that water. So, that is the irrigation requirement and multiplying with your area you get the volume right and volume divided by you know 10 hours you get the discharge. So, knowing the discharge and the head and you can estimate the power ok. So, power and finally, the input horsepower so, that will be estimated by water horsepower divided by all these efficiencies. So, that is finally, the input horse power required to operate the entire system ok.

So, coming to the solution here the field capacity is given, 32 percent 0.32 wilting point 20 percent and bulk density you convert that into gram per centimeter cube ok.

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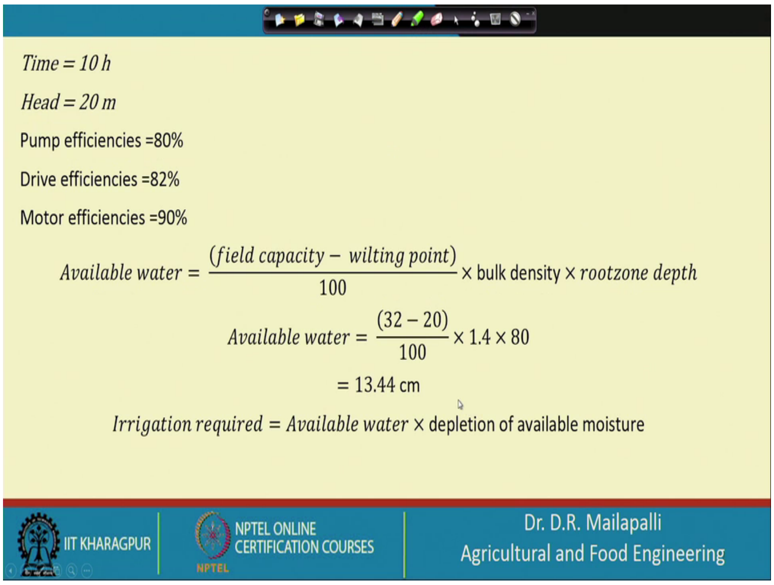

So, then the other input parameters or like time 10 hours head 20 meter and the pump efficiency drive efficiency and motor efficiency are (Refer Time: 11:02) given. So, available water now the field capacity minus wilting point right into bulk density into root zone depth. So, why we are multiplying the bulk density is since, these are gram metric means weight basis right, these are weight bases and if you can multiply bulk density then this will be in volumetric basis right; volume by volume basis and then multiplied by root zone depth.

So, as you get 13.44 centimeter. So, that is the water available in the root zone. And then, but irrigation requirement is 40 percent of that right.

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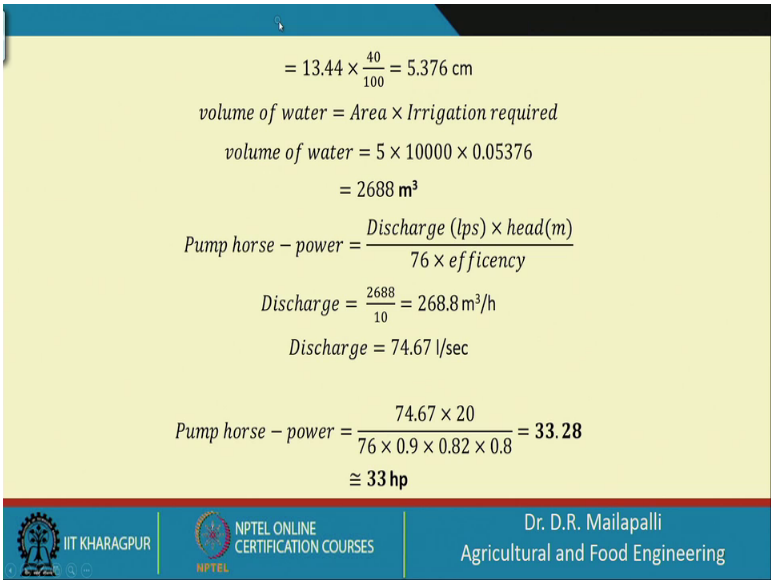

So, now, if you can use this, this is the available water multiplied by 40 percent you get 5.376 centimeter we have to apply right. So, volume of water will be area into irrigation requirement. So, that will be this much volume we needed to apply, but what is the discharges? The discharges is 10 hours because this volume has to be applied in 10 hours. So, this is you will discharge and in liter per second convert liter per second right.

And then you can use this equation to find out the horse power and putting the discharge in liter per second head in 20 meters I mean meters in 76 is the conversion; the efficiency is all motor I mean pump efficiency drive efficiency motor efficiencies altogether. So, you get the 33 hp of pump is required to operate the entire system for 10 hours in order to irrigate in the field at 40 percent depletion of available water ok.

So, with this tutorial; so, in this mainly the in the tutorial, so, whatever we covered in the in this week. So, we got some important you know the questions which are from GATE exam hm. So, we solve those and in addition to this you can also you know go to some other relevant books to find out the relevant you know the problems and solve yourself. And the then next class we will be focusing on I mean with this the Welson pumps section is done in the last 2 weeks. And from next week onwards we will be focusing on drainage part; rights on the drainage the basic principles of drainage, design of drainage and the salt affected lands and what is the salt affected lands all those things we are going to learn. And then what are the types of drainages right installation procedure and in the some case studies of drainages. So, all these things will be covering the rest of I think the 5 weeks ok.

Thank you so much.