**Electronics for Analog Signal Processing - I**
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Lecture - 3
Diode Characteristics

In the last class, we understood something about diode function generation. That is, any nonlinear function between voltage and current can be generated, synthesized, using the ideal diode, in combination with resistors and voltage sources.

Let us solve this example. Obtain a diode function generator with characteristics as shown. This is the sort of a piecewise linear characteristics that we want, non linear characteristics that we want generated, using ideal diodes and resistors.

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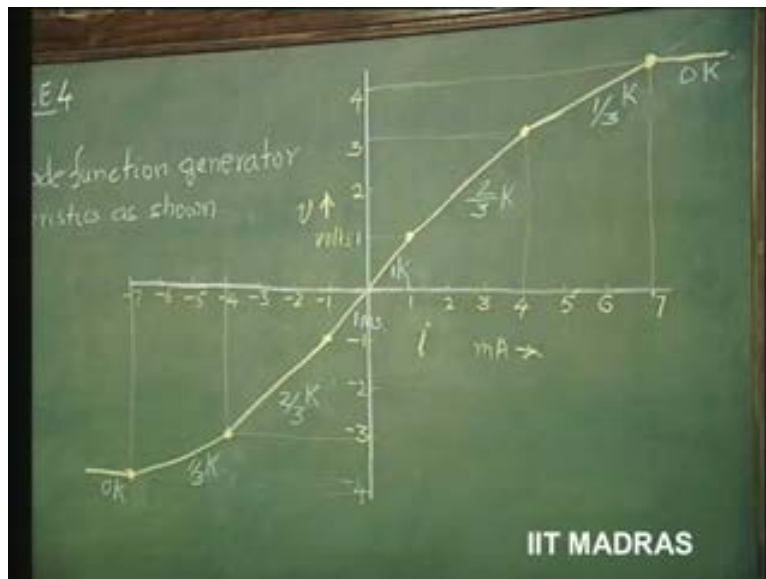
This is the problem given to you for synthesis. Let us see how to synthesize such a circuit. Let us examine this circuit here first. There are near about zero, we have a slope here, corresponding to v equal to 1 volt, current equal to 1 milliampere. So, 1 volt by 1 milliampere is equal to 1 kilo ohms. So, this corresponds to a resistance of 1 kilo ohm.

So, when v is around zero and i is around zero, the slope of this characteristic is 1 kilo ohm. So, it should represent 1 kilo ohm. So, I am just putting here, let us say, this is the black box initially generating this portion of the waveform. Let us concentrate on this portion of the waveform, that is, when both v and i go positive. So, v is positive with respect to this, i is positive this way.

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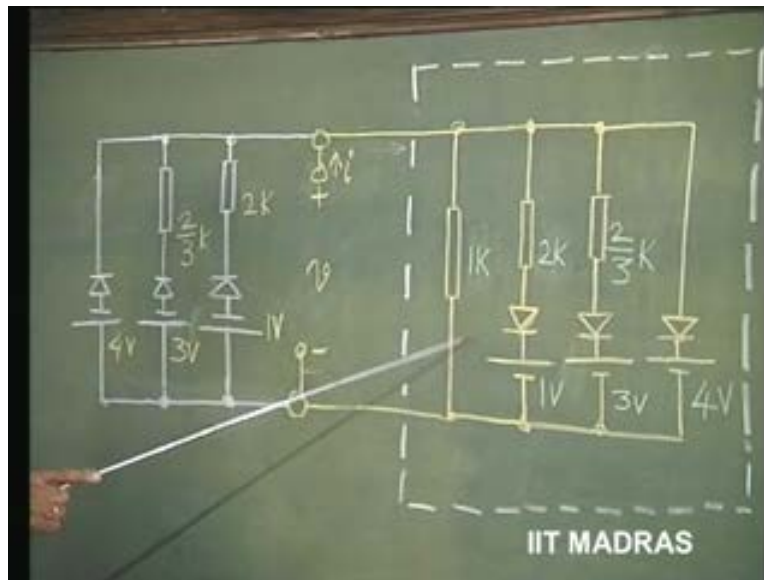
So, when v is positive and i is positive, we have this 1 kilo ohm resistance giving the required slope here, so that is alright, that is straight forward, and during that time, these diodes as also these diodes will be all off. That is because, these diodes will come into conduction only when the potential of this is higher than this by 1 volt. With respect to the common terminal, the potential here should be higher than this by 1 volt. Similarly, potential here should be higher than this by 3 volts. That is why these diodes, let us call these as D1, D2 and D3, these are going to be off.

So, these are all going to be open and therefore the only resistor that comes into picture here between these two terminals is 1 kilo ohm, resulting in this slope.

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Now, as soon as the voltage v reaches a value of 1 volt, this is what it says, as soon as the voltage v reaches a value of 1 volt, the slope should change, that is what is indicated in this figure. Up to that point v equal to 1 volt, the slope should be 1 kilo ohm; thereafter, it should be 2 by 3 kilo ohms. So, that means, I should bring in another resistance because it is less than 1 kilo ohm. I should bring in another resistance in parallel with 1 kilo ohm; that means, 1 kilo ohm in parallel with another resistance should be equal to 2 by 3 kilo ohms.

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So, 1 kilo ohm, in parallel with 1 into R by 1 plus R, that is a parallel combination, is two thirds kilo ohm. So R is going to be equal to 2 kilo ohm, because R, if it is 2 kilo ohm, 2 into 1 by 2 plus 1 is two by thirds. So, R comes out as 2 kilo ohms.

So, I have to now bring in a resistance in shunt with original 1 kilo ohm so that, R into 1 by R plus 1, that is, parallel combination of two resistors, happens to be equal to two thirds kilo ohm. From this equation, we get R as equal to 2 kilo ohm. So, 2 kilo ohm has to be brought in shunt with 1 kilo ohm. That is what this arrangement does. This 2 kilo ohm is going to be brought in shunt with the original 1 kilo ohm at exactly a voltage 1 volt and above.

So, the moment this voltage crosses 1 volt, this diode starts conducting and therefore, this is going to be a short circuit. Therefore, 1 kilo ohm is going to be in shunt with 2 kilo ohm, resulting in a slope of two thirds kilo ohm.

So, we are now bringing in these resistors in steps - 1 volt, the moment v becomes 1 volt or greater, this resistance is coming into picture and therefore this is a short for that.
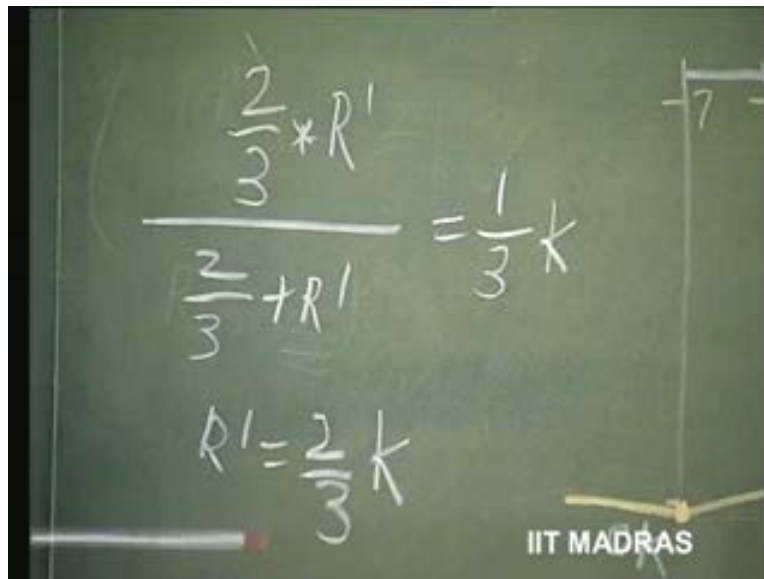
So, we can just say that this is going to be replaced for that range above 1 volt; you had to solve the equation this way. This 1 K is coming in parallel with 2 K, so this is a short.

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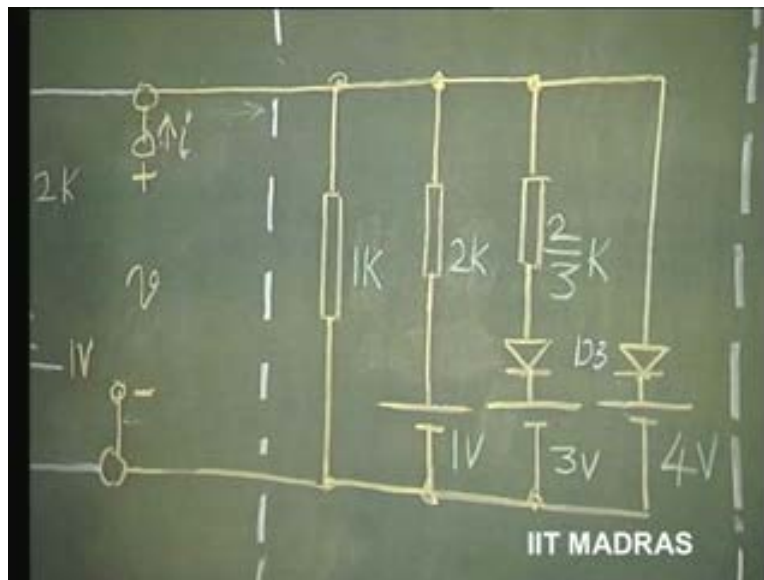
Let us therefore say that above 1 volt, D1 conducts, so this, we can say here, D1 conducts. Now, as voltage further increases, this v, as soon as it takes on a voltage equal to 3 volts, D2 conducts, because this is maintained at 3 volts. This potential, if it is higher than 3, equal to 3 or higher than 3, this diode will conduct, D2 will conduct, and bring in another resistance in such a manner that now the equation will change. The effective resistance earlier was two thirds K, so, two thirds parallel, let us say, R dash divided by two thirds plus R dash; that should be equal to 1 by 3 K.

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So, this is the equation that you have to solve. Two thirds K parallel with whatever resistance that is going to be brought after 3 volts is reached, divided by two thirds plus R dash is equal to one third K. So, R dash will become equal to two thirds K. So, that means, if I now bring in another resistance R dash in parallel with this combination, 1 K 2 K after this voltage reaches 3 volts, then we have effectively a slope of one third K for all voltages above 3 volts. So, it will go on like that. So, we have evaluated the value of resistance to be brought in, in order to make this slope from two thirds K to one third K.

The resistance to be connected in parallel is two thirds K. So, two thirds K in parallel with two thirds K is one thirds K. Finally, after 4 volts is reached, therefore let us see, above 3 volts, D2 conducts.

Above 4 volts, we want the slope to be zero K. This should be a short circuit. That means, the voltage has to be maintained at 4 volts irrespective of the current increase, so the slope is zero K.

So, what it means is, there should be no resistance brought in shunt, no resistance brought in shunt; the moment this voltage reaches 4 volts, this diode conducts and it shorts the

entire thing, so this slope becomes equal to zero K. So we know that we should bring in a short circuit after this voltage reaches 4 volts. So, we have now this entire combination giving a nonlinear characteristic of this type, for v greater than zero.

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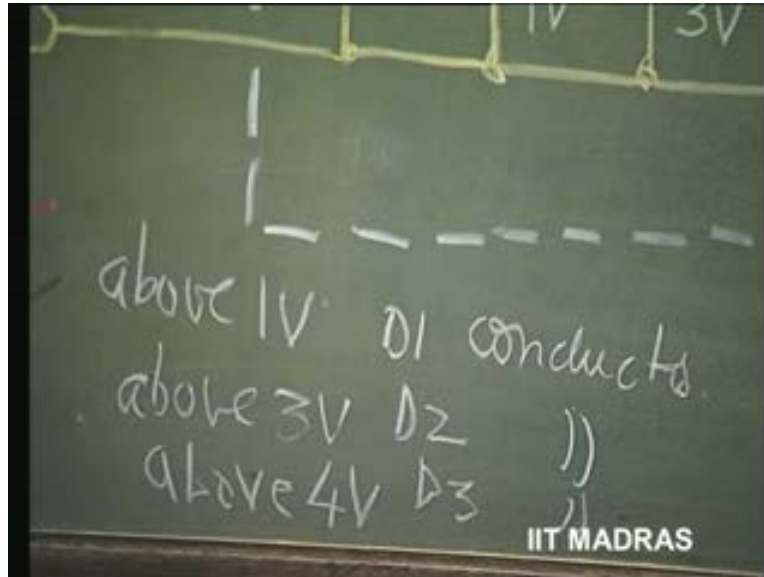
Let us now consider, again for completion, above 4 volts D3 conducts. So, we have this story here, D1 conducts above 1 volt, D2 conducts above 3 volts, D3 conducts above 4 volts.

So, we have here, for zero to 1 volt, none of these three diodes conducting, 1 to 3 volts, D1 conducting, 3 to 4 volts, D1 and D2 conducting, above 4 volts, D1, D2 and D3 conducting. So, that is how, this portion of the characteristic is built up.

Now, for the negative, it is the same story repeated, except that, for zero to minus 1 volt, 1 K is there and then minus 1 to minus 3 volts, two thirds K is there, and minus 3 to minus 4 volts, one third K is there and above minus 4, that is, more negative voltage, it is going to be zero K.

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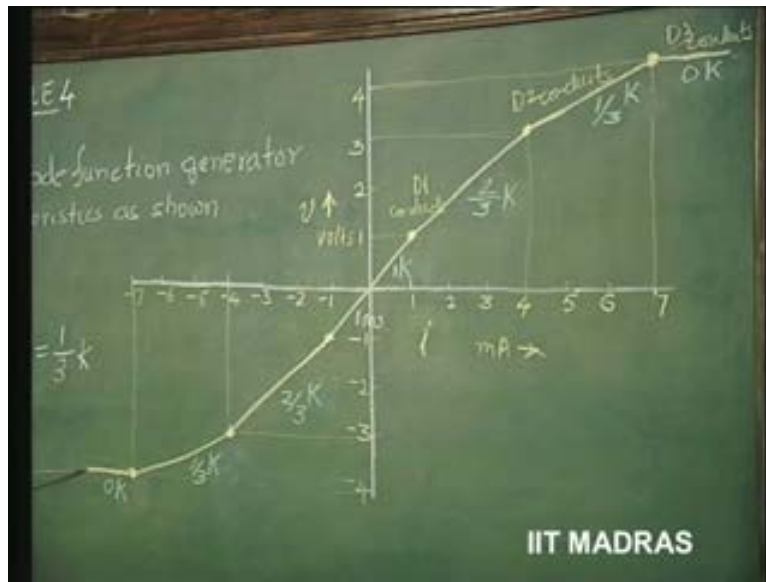
That means, we can obtain this portion of the characteristic exactly using similar set of diodes, D1 prime let us say, D2 prime and D3 prime we will call it. I am putting it on to this side, D1 prime, D2 prime, D3 prime and voltages which will be minus 1 volt, minus 3 volts and minus 4 volts, minus 1 volt, minus 3 volts and minus 4 volts.

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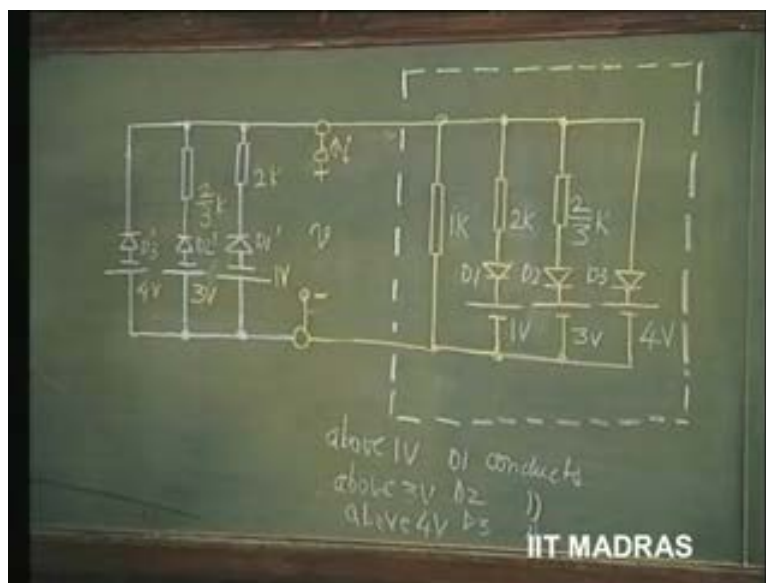
Diodes put in the opposite direction to D1, D2, D3. So, they start conducting when this voltage is more negative than this. If this is minus 1 volt, when this becomes more negative than this, this starts conducting. When this becomes more negative than this, that is, if this is minus 3 volts, when this is more negative than minus 3 volts, this starts conducting. When this is minus 4 volts and this is more negative than minus 4 volts, this starts conducting.

So this entire characteristic gets sort of almost retraced here the moment we put this in shunt with this combination of circuits. So, this combination in shunt with this combination gives the complete characteristics that we have depicted here. Here, I have made it somewhat symmetric around this so that the slopes are the same for both positive going as well as negative going voltages. That need not be the case in any general situation; these slopes may be different from these slopes and therefore, in general, I can get any nonlinear characteristic which is of this type, using a combination of diodes and resistors. This whole complex thing is called a diode function generator.

In Example four, we solved a problem of non linear resistor synthesis; a plot between voltage and current of a two terminal network. What was discussed? Nonlinear resistor synthesis or nonlinear conductor synthesis, v versus i.
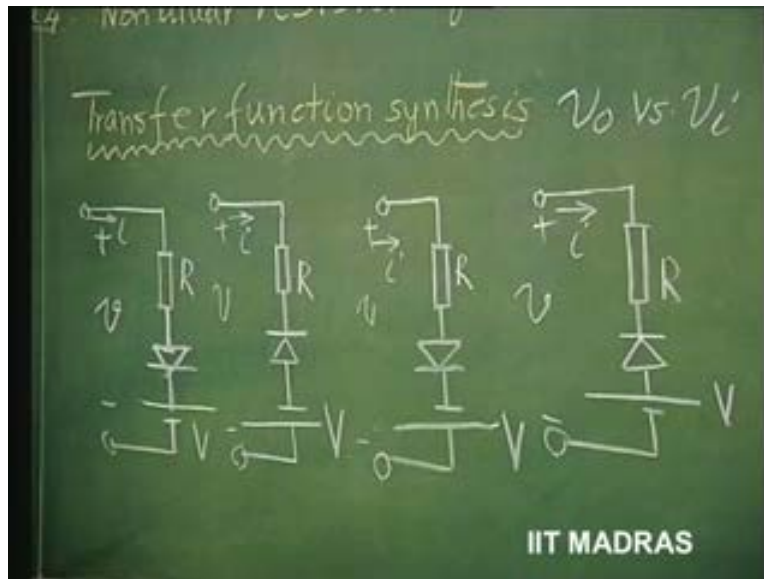
Now we will go to another important synthesizer, that is, transfer function synthesis. What it means is, we want an output voltage as a function of input voltage; transfer function synthesis - out put voltage as a function of input voltage.

Therefore, this can be two port network like this, output voltage as a function of input voltage; two port - this is called input port, this is called output port.
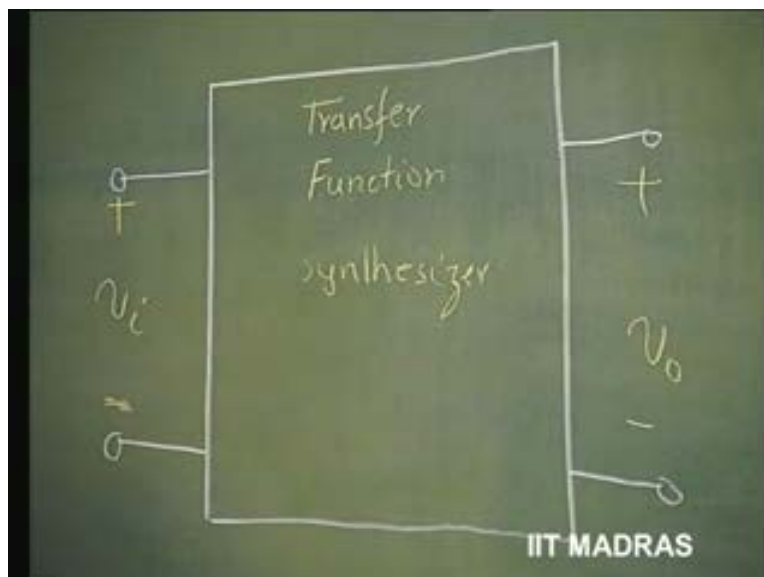
It is four terminal network, four terminal network or two port - input port and output port. I would like to put a network here so that I get the desired v naught versus v i characteristics; such a synthesis is what we would like to do.

For that purpose, we need the same combination that we had used, the diode resistor battery combination that we have earlier used. So, I will now put a general block of diode and resistor which will be useful for any synthesis in practice, whether it is transfer function synthesis or non linear resistor synthesis. These are the possible four combinations of using resistor in series with the diode and a battery. So, these four combinations are the only possible combinations that we can have for this synthesis problem.

Let us therefore try to understand each of these blocks. This is the block that we have already used in Example four wherein, if this voltage is positive and this current is defined this way as positive, then, this diode is going to conduct when this voltage is higher than this voltage by this magnitude, whatever battery voltage we are connecting here. If this is 1 volt, this, when it goes above 1 volt, this diode is going to conduct and these resistors will be coming into picture beyond that voltage, above that voltage. So, this, we had used in Example four.

This is another one that we had used in Example four where this resistor came into picture when this voltage here was more negative than this voltage. Let us say, this is minus 1 volt, when this is minus 1 or minus 2 or minus 3, this diode conducts, and for all those voltages which are more negative than this minus 1 volt, this resistor will come into existence. This diode is a short circuit.

Now, the other two combinations which we had not used in the example are these. The resistor remains the same, the diode direction remains the same; therefore, the current direction possible is only in this. So this current is positive, but this resistor comes into picture for voltage v if this is, say, 1 volt for this voltage, which is greater than, that is,

this is minus 1 volt, this is more positive than minus 1 volt. That means, beyond minus 1 volt, this resistor exists. This is minus 1 volt, let us say, minus 1 minus let us say, point 5, minus point 2 5, for all these voltages which are more positive than minus 1 volt, this diode conducts.

That means, for positive voltages any way, this is all the time existing, and also extends up to minus 1 volt, this resistor comes into picture. Here, this resistor comes into picture if this is let us say, 1 volt. It is positive; so, if this is more positive than 1 volt, this resistor doesn't come into picture; if it is less than 1 volt, this resistor exists. So, this is a short circuit as long as this voltage is less than 1 volt.

So, with all these four combinations, we can synthesize, bring in a resistor or disconnect a resistor. Across the two terminals, we can bring in any resistor we want depending upon whether we want the resistor at higher values of voltage or lower values of voltage. We can disconnect a resistance or connect a resistance using these combinations of diodes and voltages.

Now, let us see how this can be used in a general transfer function synthesis. Before we bring in resistors and diodes, let me just connect only resistors here - two resistors - and make a very simple transfer function synthesizer which is popularly called as attenuator, resistive attenuator. This is commonly used in electronics for attenuating a voltage from some value to another value.

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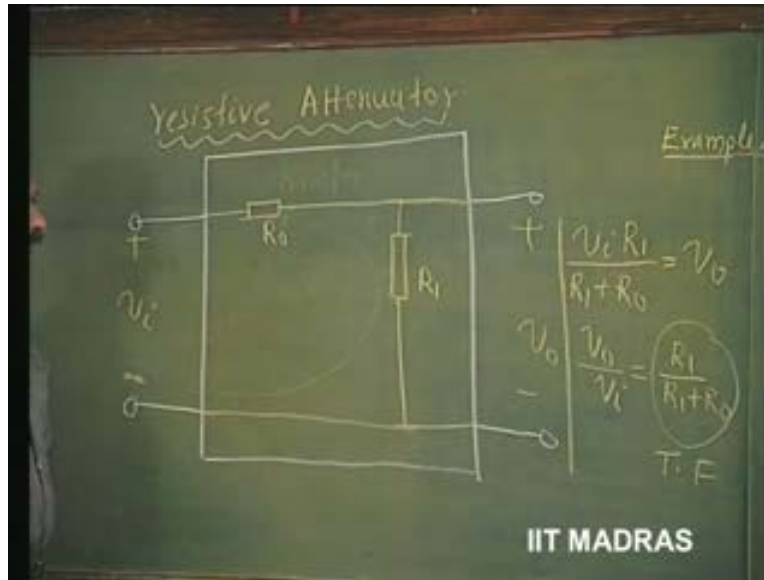
So, if this is, let us say, R naught and this is R 1, we know that the current in this circuit is going to be vi divided by total resistance R 1 plus R naught, that is the total resistance, and i am taking the voltage across R 1, so that is equal to v naught. So, the transfer function v naught over vi is equal to R 1 by R 1 plus R naught.

This is what is called as transfer function. The input is transferred to the output by a factor which is this; that is why it is called transfer function; transfer of input to the output with this kind of attenuation.

So, this is a simple resistive attenuator which is common place in your cathode ray oscilloscope and such other meters etcetera; this is quite common place. When I want very high voltage to be measured, I would like to put an attenuator and then reduce it so that the equipment utilizing this voltage doesn't get damaged.

So, this resistive attenuator, I want to modify in such a manner that this attenuation factor changes depending upon the voltages and currents that I want. So that is a non linear transfer function synthesis. This is linear; irrespective of the magnitude of voltage at the input, this relationship remains the same - R 1 by R 1 plus R naught.

Now, I would like to change this depending upon the magnitude; that means, it becomes non linear magnitude of input voltage. I would like to change the characteristic of the transfer function.

So, I would like to do what is called as non linear function generator. So, if this is v naught and this is v i, linear function here, or let us say, this is an attenuation factor R 1 by R 1 plus R 2, R naught, R 1 by R 1 plus R naught is the ratio here.

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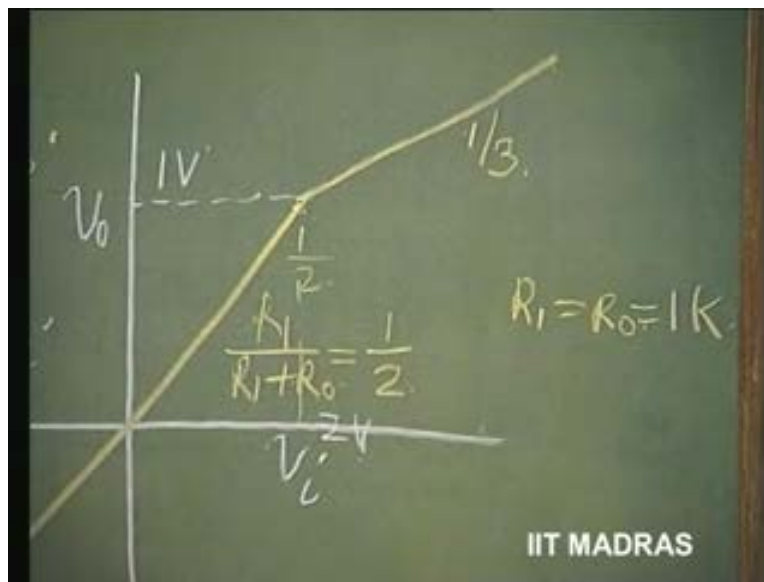
Let us say, this is equal to half. I make R 1 equal to R naught and I will have this at half, R 1 is equal to R naught.

Take this example. So, the ratio is half. I would like to change this when the output voltage reaches, let us say, this is 1 volt. When this is 1 volt, this should have been 2 volts, so that the slope here is 1 divided by 2 volts, so half.

So, I want to change this slope from half to some other value, lesser value. That I can do by shunting this R 1 by appropriate resistance, so that this slope reduces. Let us say, from

half to, we would like to bring it to, one third. So, I would like to bring in another resistance here after a certain voltage is reached, let us say, 1 volt is reached.

So, I now bring in another resistance R, let us say, 1 prime, such that, so I want to bring in a resistance. Therefore, the diode should start conducting when the voltage here is, at the output, is equal to 1 volt. It is very clear.

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So, I just put a 1 volt here. So, moment this voltage becomes greater than 1 volt, this resistance comes into picture, R 1 prime, such that I have the attenuation, which is, R 1 prime parallel R 1 divided by R naught plus R 1 prime parallel R 1 is equal to 1 by 3. That is the slope that I want. From half, it should change to 1 by 3.

So, you can now understand, effectively, if this is 1 K, originally I said, R 1 is equal to R naught equal to, let us say, 1 K we put; so, 1 K by 1 K plus 1 K is half.

So, I now bring in another resistance R 1 prime in such a manner that the slope now becomes, it should change to, 1 into let us say half divided by 1 plus half.

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So, the parallel combination of R 1, R 1 prime, should become half a K so that, this becomes equal to 1 by 3. 1 K, parallel half a K, will make it 1 into half divided by 1 plus half, which is nothing but 1 by 3.

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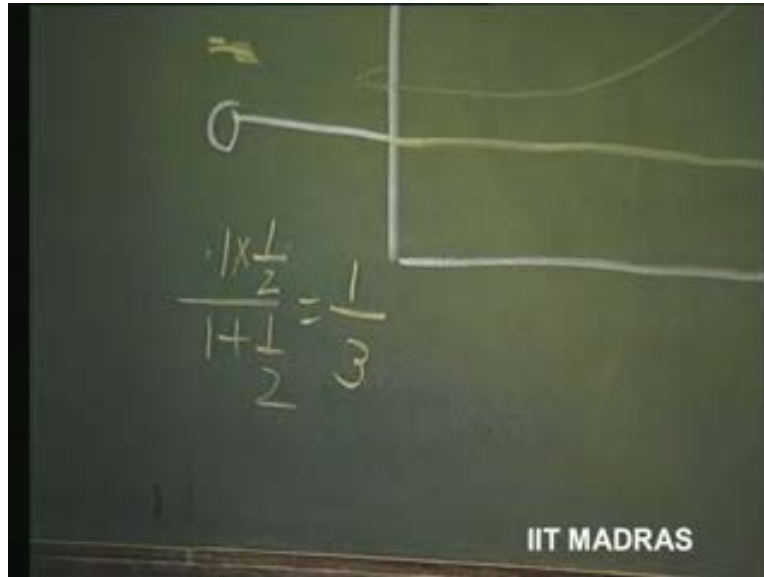
So, I should bring in another resistance here, 1 K, so that the parallel combination of these two - 1 K and 1 K becomes half a K. So, I simply put a resistance here which is, let us say, this is 1 K, this is 1 K, this has to be brought in as 1 K. So, automatically, this slope is changing over to 1 by 3. If I at another later date, another voltage, I want to reduce this slope further, let us say from one third to one fourth, I can do it by bringing in another resistance at the specified voltage. So, the synthesis of this transfer function becomes very simple fact.

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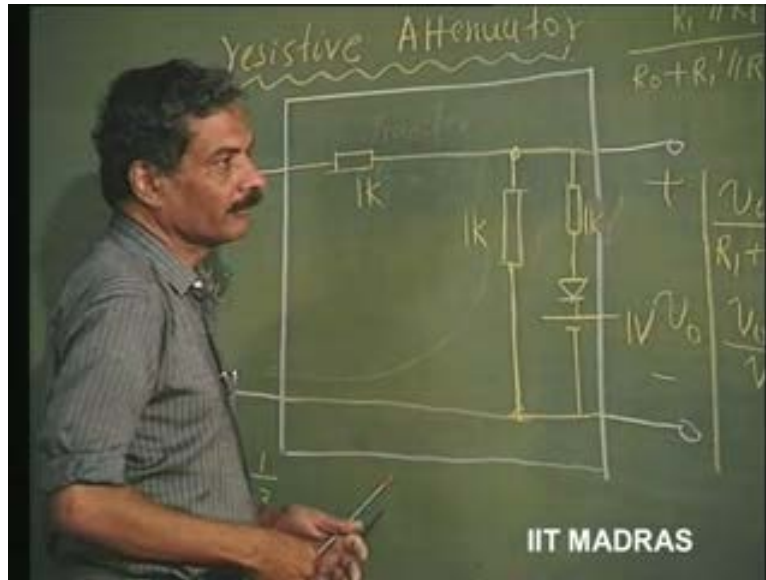
So, let us say, I am not going to do that that way. I want this slope here to finally become equal to at, let us say this is 1 volt, let us say, if it is 1 point 5 volt, I want the slope to become zero.

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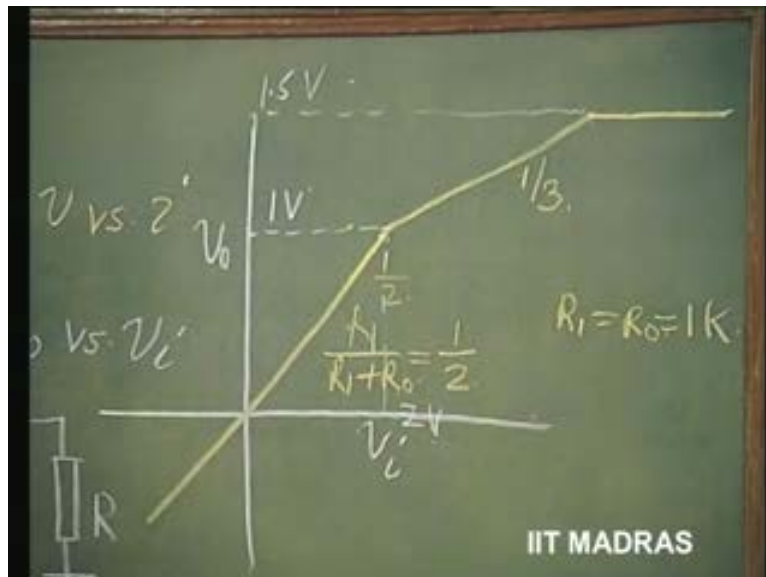
That means, I should bring in zero resistance there across this so that the output voltage remains constant at 1 point 5 volts irrespective of the input voltage. So, we can see here

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that I can now bring in zero resistance at a voltage of 1 point 5 volts. This is 1 volt, this is going to be 1 point 5 volts, so that the slope becomes equal to zero. This is the synthesis for this portion of the circuit.
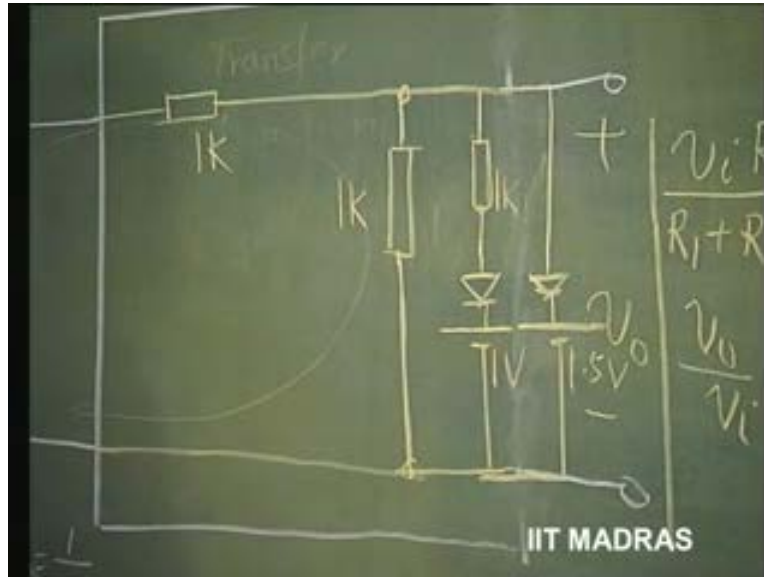
Now, similar synthesis can be done for the other portion by bringing in resistances. If I want to change the slope somewhere here, at that appropriate value of voltage, negative value of this thing, voltage, I should bring in another resistance so that the slope changes to some other value; so on and so forth.

So, using the combination of these resistors, diodes and battery, I will be able to synthesize any such diode function generator which is nothing but a nonlinear resistive attenuator, and we can obtain all these battery voltages from a single battery. That is what I would like to discuss now.

This 1 point 5 volt is the highest battery voltage, let us suppose, needed in the positive side. Then, how can I derive 1 volt from this 1 point 5 volt? I normally require a 1 volt battery with some resistance in series. So, I should be able to derive from the 1 point 5

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volt battery the highest value of voltage available in the positive side; other voltages which may be required for synthesizing.

This, I cannot afford to keep on putting all values of battery voltages here; I should be able to derive it from a single battery. Let us say, if you have a six volt battery, you have to derive all these voltages from that six volt battery. This is the portion I would like to discuss now separately.

So, how to sort of obtain from a given battery of V volts, any value V dash, with a series resistance of R? This you have studied in your network, I am sure, V dash, let us say; so, how do you obtain from this?

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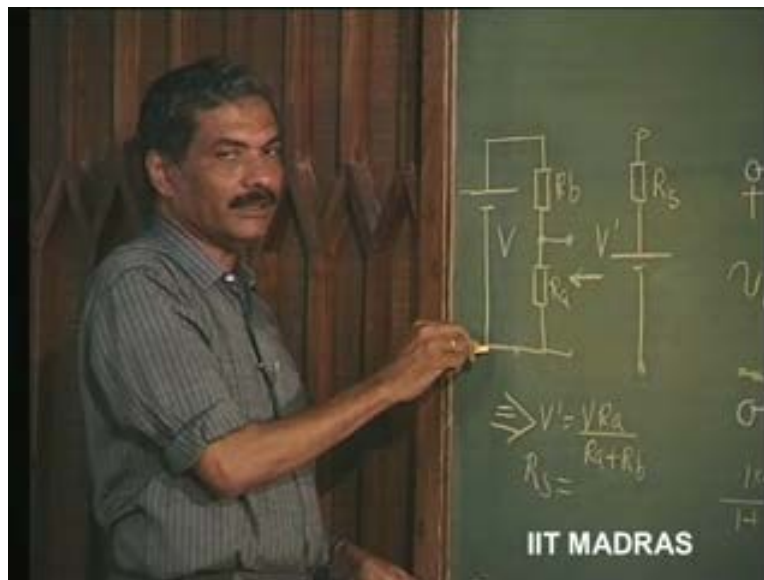
What you do is, you will put an attenuator here, let us say, Ra and Rb, and observe the voltage here. If you convert this into Thevenin's equivalent, this voltage, battery voltage, with this kind of attenuator is equivalent to an attenuated voltage, which is nothing but V into Ra by Ra plus Rb. That means, V dash is equal to V into Ra divided by Ra plus Rb.

Thevenin's resistance Rs is equal to, short circuit all the voltage sources and open circuit all the current sources if they are there. In this case, only voltage source is there, short circuit the voltage source, and find out the impedance seen from here.

So, the impedance seen from here, if I short circuit this, is nothing but Ra parallel Rb; so, Ra parallel Rb.

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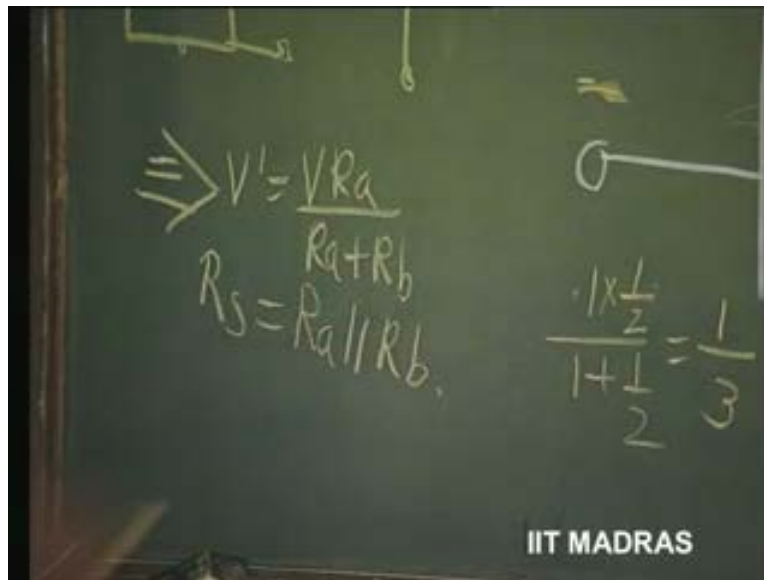
Let us, for example, try to derive this. I want 1 K in series with 1 volt to come into picture in series with this diode. I have only 1 point 5 volts battery; so, let us take this example. I have 1 point 5 volts. I would like to get this voltage which is 1 volt in series with a resistance I want of 1 K.
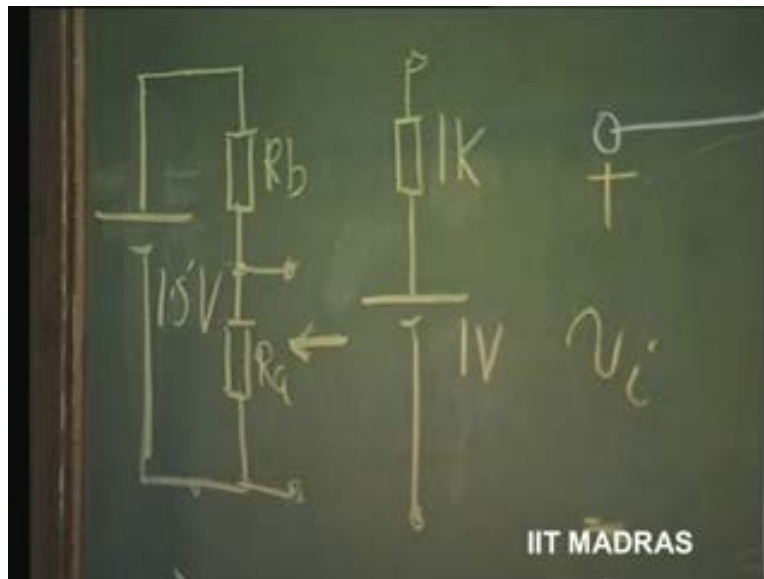
So, given that this problem exists, we can now see that V dash is going to be 1 volt I want from V, which is equal to 1 point 5 volts. So, you know that Ra by Ra plus Rb therefore becomes equal to 1 by 1 point 5 or 2 by 3.

So, this ratio, Ra by Ra plus Rb now gets fixed because of this as 2 by 3. What about value of Ra parallel Rb? Ra parallel Rb which is nothing but Ra Rb divided by Ra plus Rb should be equal to 1 K; that is what I want.

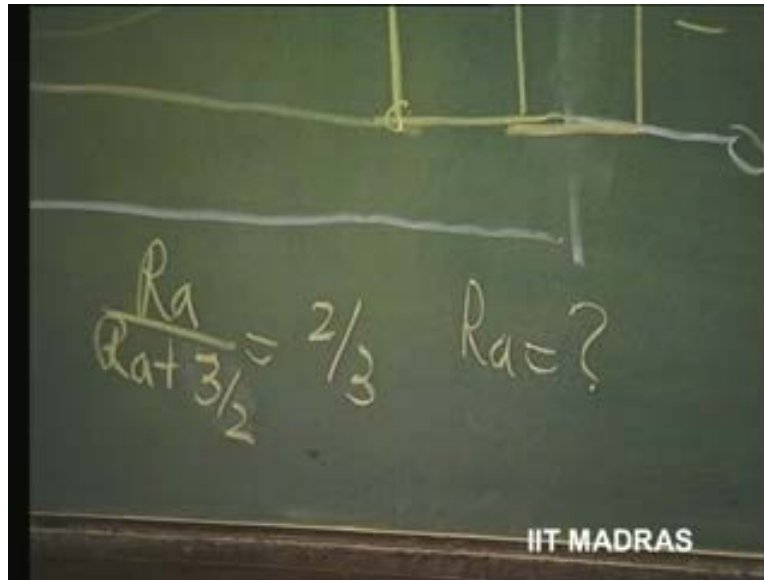So now, Ra by Ra plus Rb is 2 by 3, Ra parallel Rb is equal to 1 K; now you can solve for this. You can actually take Ra by Ra plus Rb as 2 by 3; so, 2 by 3 Rb, Ra by Ra plus Rb is fixed as 2 by 3, it is equal to 1 K or Rb is equal to 3 by 2 K.

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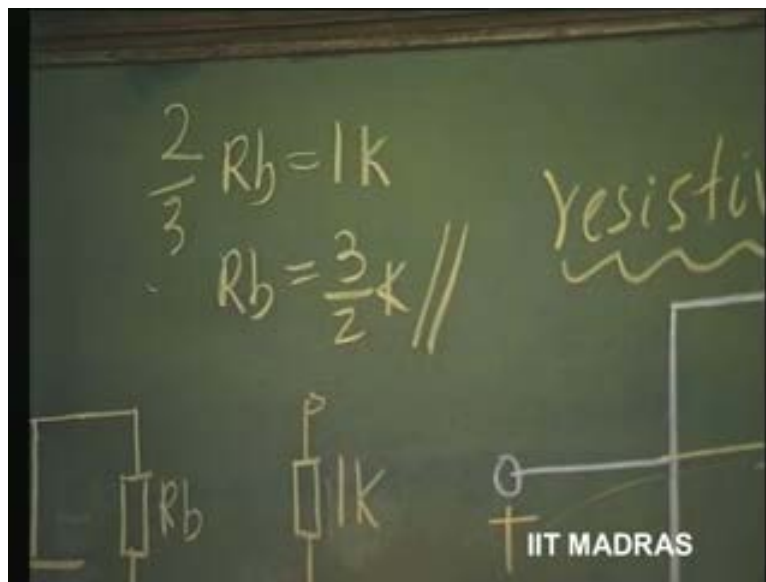
This is the solution and Ra parallel Rb, in fact, Rb is equal to 2 by, 3 by 2 k and therefore Ra by Ra plus Rb is equal to 2 by 3.

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So, you can re substitute this value of Rb, 3 by 2 K. <mark>Let us now solve for Ra</mark>. So, we can solve any such problem in general by using this Thevenin's equivalent for a voltage source.

Similarly, if I am using negative voltages, take the highest value of negative voltage you are likely to use. From that highest value of negative voltage, you can derive all the other negative voltages which may be necessary as voltage sources in series with resistors by using the same theorem.

I would like to leave this as a problem for you to solve. I am going to give you a problem which you have to solve before you come to the next class in order to understand this whole concept of transfer function synthesis.

So, the problem is going to be: obtain a non linear resistive attenuator whose characteristic is going to be as shown, using only two batteries and resistors.

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So, this is the problem. Obtain a transfer function synthesizer with the characteristics as shown. Let us see the characteristics here - v naught over v i. I want it this way - v naught over v i.

It should change its characteristics first at v naught over v i. Let us say, v naught equal to 4 volts. The slope up to that point is going to be, let us say, half. Then, it should change over to, say, 8 volts. It should change over above 4 volts to one third. After that, it should change over to 1 by 4. Let it remain like that forever. For all the higher voltage, let it remain as one fourth volt.

Here, in the negative side, let us say, it changes over at minus 5 volts output. It changes over to, let us say, one third; then, at about minus 10 volts, it becomes zero.

So, this is the problem I have given you. You are asked to synthesize the diode function generator which can give a transfer function characteristic of this type. Once again, at output voltage equal to 4 volts, the slope changes from half to 1 over 3; at output voltage equal to 8 volts, this slope changes from one third to one fourth and remains like that.

Here, for more negative voltage than minus 5 volts output, the slope changes from half to one third; but beyond minus 10, no negative voltages; it goes to zero.

So, I would like you to work out this problem using only two batteries and diodes and resistors.

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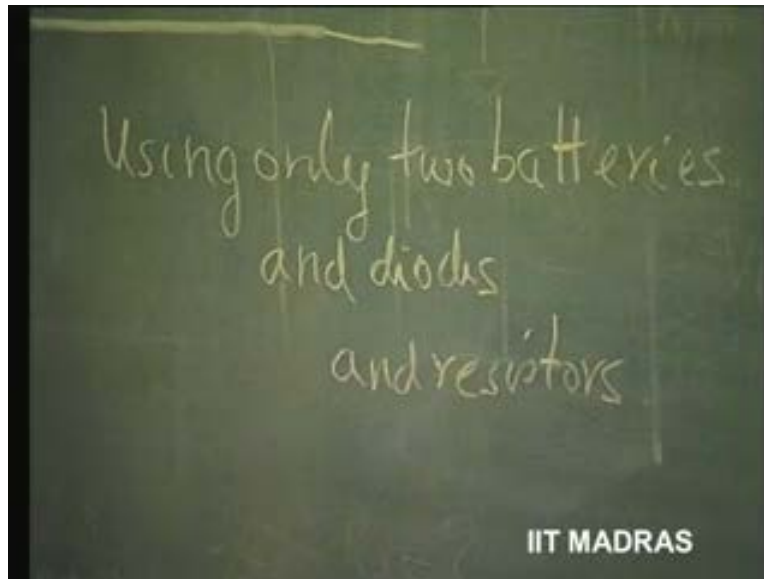
We had just seen how a diode function generator for obtaining a non linear transfer function can be obtained, using diodes, resistors and voltage sources batteries. Now, I am going to pose the problem from an application view point in the following manner.

This is Example 5. Convert a triangular waveform to a sine waveform.

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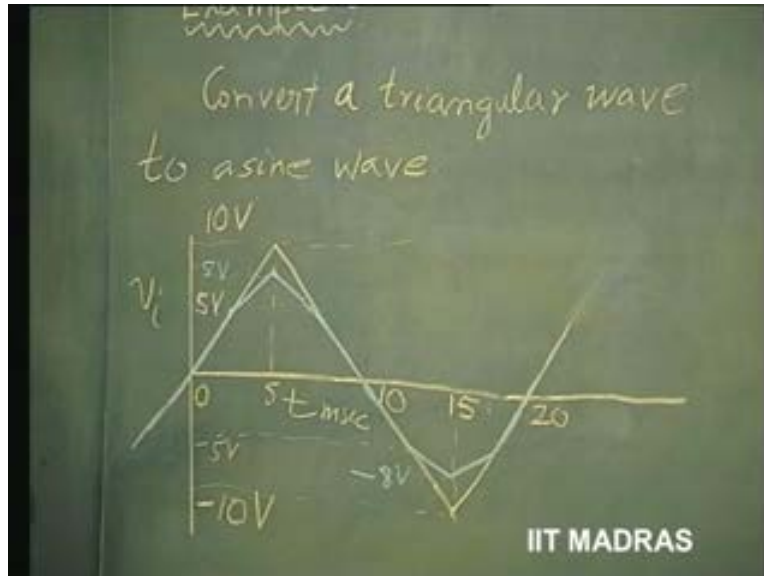
So, this is a nonlinear function. A triangle, if it is just retained as a triangle, subject to attenuation etcetera, is a linear operation. The triangle is getting converted into a sine wave. So, that means, you are shaping the waveform in between, according to the voltage level, the sort of transfer function is going to change. Triangle will remain a triangle up to a certain point; then, it is going to sort of get attenuated steeply by bringing in large attenuation factors, etcetera. This is what is going to be done by the diode transfer function generator. How are we going to do this?

So, this is the application. This is a triangle, periodic triangular waveform, with the time period of twenty milliseconds. Twenty milliseconds means, in terms of frequency, it will be fifty hertz. Typically, our power line frequency waveform, if you find out the time period, it is going to be twenty milliseconds. Let us say, we have a triangle with that kind of period, of twenty milliseconds.

I would like to convert this into something which is approximate to a sine wave, which means, in this particular region, it is almost going to look like a sine wave. The triangle

itself looks like a sine wave and here, instead of going to a peak like this, it will go to a lesser peak. In this region therefore, it is here, it is going to follow the triangle with the same slope as the triangle. But here, the slope is going to be lesser than that of the triangle. It could be made still less if it is this way. So, depending upon our approximation, we can actually manipulate this peak wherever we want.

In place of this kind of approximation, we can bring in more number of segments so that it can approximate the sine wave better. But, for the time being, for simplicity, we will see how this portion of the output waveform can be got by using a diode function generator.

So, our problem is to synthesize a diode function generator, given that, I have to convert this triangle into some kind of piecewise linear approximation to a sine wave. So, how do I go about doing it?

Let us look at, examine, the thing. At this point, where the input voltage is around zero, both positive or negative, the slope of the triangle is the same as the slope of the sine wave approximation, which means, for a change in output voltage divided by a change in input voltage, this is going to be 1. Suppose, this changes by some amount during this time, the output also should change by the same amount during the same time.

So you can see, let us say, up to this time, whatever be the voltage change that is occurring in the input should be occurring at the output also. This colored waveform is the output waveform, let us say.

So, Delta v naught by Delta v i is equal to 1. That means, it should not attenuate. Given the triangle, the transfer function should not attenuate. So, let us draw that kind of attenuator.

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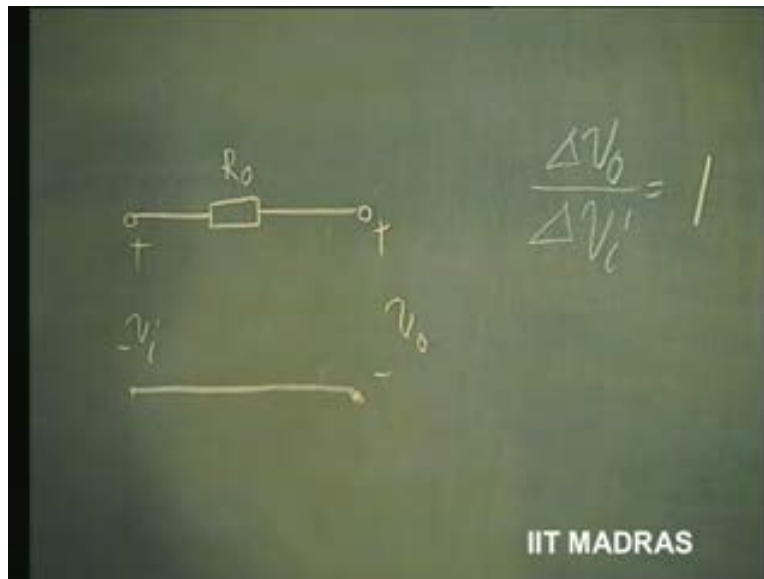
This is the output, this is the input. That means, this resistance should be infinity, so that, output is equal to input, Delta v naught by Delta v i is equal to 1, output is equal to input. Whatever change occurs at the input is reflected as such at the output; no attenuation.

So, this is fine. Any value of r naught I put, I get output equal to input. So, up to this value of output voltage equal to 5 volts, this should remain like that; thereafter, I should bring in a resistor so that output slope, output is attenuated more than the input. The input goes on like this, but output is going to be an attenuated portion of the input, not the same as the input.

So, I bring in a resistor here with voltage equal to 5 volts. This is what we had discussed earlier; output, when the output voltage is 5 volts, I bring in a resistance.

So, we have this resistance, let us say, R, coming into picture, as soon as this output voltage becomes equal to 5 volts. What should be the slope? The slope should be, thereafter, Delta v naught by Delta v i is nothing but R divided by R plus R naught; because, the diode is a short circuit thereafter. So, slope is changed to R by R plus R naught. That is equal to, let us find out what the slope is, should be.

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There is a change in voltage of 5 volts to 10 volts in this region during this time and output changes only from 5 volts to 8 volts. So, output has changed by only 3 ohms - 5 volts to 8 volts. Let me clearly mark it so that you know how that 3 volts comes about.

Output has changed from 5 volts to 8 volts, when the input is changing from 5 volts to 10 volts; so this is equal to 3 by 5. So, if I put here, let us say, R equal to 3 K, R naught should be equal to 2 K. Simple thing. So, if I put R as 3 K, this will be 3 by 3 plus 2, so that, if I put R naught equal to 2 K and R equal to 3 K, we get this curve.

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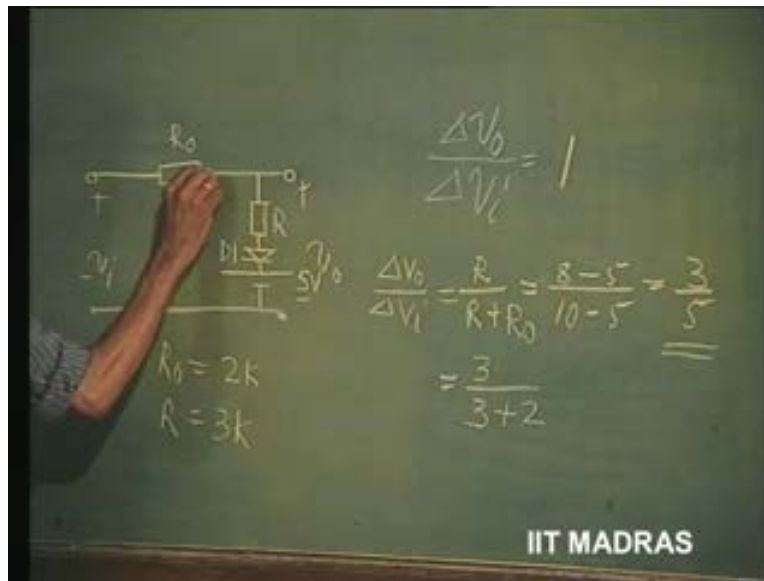
In the negative side actually, when the voltage is decreasing, same thing is followed; whether it is increasing or decreasing, same thing is followed. So, in this portion of the waveform, the diode is conducting, diode D is conducting, and therefore diode D 1 is conducting, and therefore this slope is brought about.

Now, this is alright up to this. After this, again, this diode goes out of picture and output becomes equal to input; it remains like that until minus 5 volt is reached. At minus 5 volts, I should bring in another resistor of the same magnitude so that it comes into conduction and makes the slope the same as 3 by 5.

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So, let us now synthesize the other portion. So, I should now bring in another resistance of the same magnitude because the slope is the same, but it should come into conduction when the voltage is negative.

Therefore, this diode conducts for that, and therefore, this voltage is equal to, again, minus 5 volts. So, at minus 5 volts, this value, this same slope is there because it is changing from minus 5 to minus 8, when this changes from minus 5 to minus 10.

Therefore, the slope remains 3 by 5 and a resistance for R naught of 2 K, you have to put R of 3 K here also. But the diode combination is changed; so, this diode comes into picture for a voltage which is more negative than this minus 5 volts, and keeps conducting and maintains this waveform in this manner throughout.

So, we have approximated now the triangle to a sort of sinusoid, using a diode function generator which is something like this. So, this is a very simple circuit. You can make any number of approximations, piecewise linear approximation, so that you get a more exact version of the sine wave than what we have approximated to.

This is the technique that is adopted in even integrated circuit function generators which very easily can generate square wave and triangular wave, and the sine wave gets generated using what is called as a diode function generator with lot more approximation than what has been done here so that, you know that, in an IC chip, whenever the triangular wave gets converted to a sine wave this is the circuit that is used.

So, this has a large number of applications in converting different waveforms from one waveform to another using a nonlinear functional relationship.

In the next session of our lecture, we will be using the same concept of diode function generator, but we want to convert now a sine wave into a unidirectional sine wave. Again, this is also a diode function generator with some kind of slope changing. Output

should be zero when the voltage is negative; output should be equal to input when the voltage is positive, that's all.

So, rectifier is a special case of diode function generator which is commonly used in a variety of applications like converters, supply generators, etcetera. So, rectifier circuit is a circuit where the input is specified. This is commonly available in our power supply, fifty hertz power supply we have. We can down convert this into whatever lower voltage we want by using a transformer.

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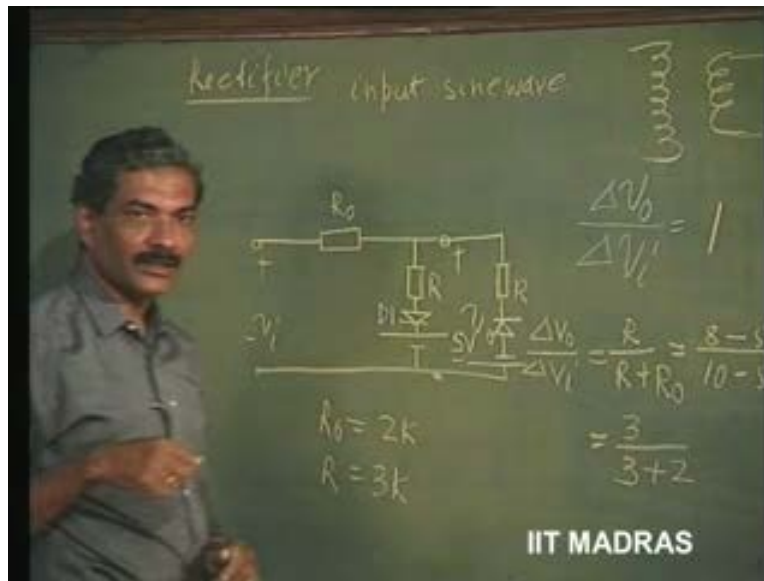
So, the power line frequency input is converted, down converted to whatever voltage level we want, and then, you can do rectification. What does it mean? We will have an output equal to input diode conducting when the voltage is positive, and output equal to zero when the voltage is negative. So, this is a transfer function generator. We will discuss this specific transfer function generator in the next lecture.