Integrated Circuits, MOSFETs, OP-Amps and their Applications
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Lecture - 42
Experiment Op-Amp Characteristics Input Offset Current

So, last lecture we have seen the input bias current, right. This lecture let us concentrate on input offset current. So, we we were we were able to measure the input bias current. I have shown you the table where you can measure V plus which is voltage and inverting non-inverting terminal, then we have seen V minus voltage at inverting terminal, then we have understood how we can calculate I b plus and I b minus and then mode of I b plus plus I b minus divide by 2, that was your input bias current.

Now, in this particular class, we will see input offset current and what exactly input offset current means.

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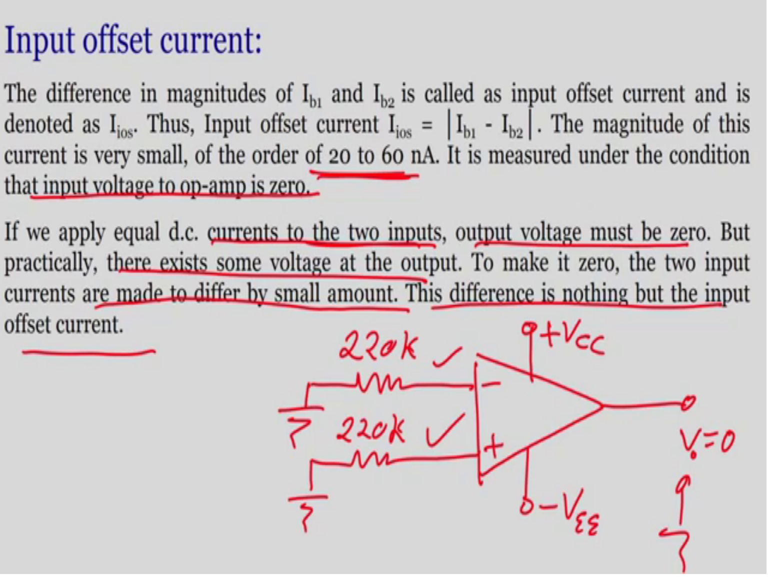

So, again you if you if you guys remember, the circuit for the input bias current the same circuit we can have for input offset current. So, the circuit was we have a resistor, we have a resistor, we have plus Vcc minus Vcc or minus Vee, right. Plus, Vcc we have output voltage minus Vee or minus Vcc, we have both the terminals ground, right both the terminals ground.

Now, this was about 220 k, 220 k inverting non-inverting this was the circuit, right if you remember. So now, same circuit we have to use for understanding the input offset current. So, what exactly input offset current means um? So, the difference in the magnitudes of I b 1 so, in that we were adding it, right. We were adding it and divided by 2, here we have to take a difference difference of what difference in the magnitudes of I b 1 and I b 2 is called input offset current. So, easy extremely easy why you have to just measure the difference, right. And is denoted as input offset current you have to remember input offset current is denoted by I in the subscript ios.

Now, thus input offset current I ios equals to mode of I b 1 minus I b 2, right? Again B 1 and b 2 would be in subscript the magnitude of this current is very small order of 20 to 60 nano amperes. It is extremely small um, and it is measured under a condition that input voltage to the op amp is 0, right.

So, what is input voltage? Guess what is the input voltage right now? Nothing right? So, input voltage is 0. So, this is the perfect condition where we can measure what is the input offset current right. So, quickly again the difference in the magnitude of I b 1 and I b 2 is called input offset current, and is denoted by I ios, thus, input of this current is nothing but difference of or magnitude of io I b 1 minus I b 2 the value is close to 20 to 69 ampere.

So, if we apply equal DC currents to 2 input. Output voltage must be 0, this is obvious, right? If we apply equal current output voltage should be 0, but practically there exists some voltage at the output. So that means, that if I ground by the terminals I will see some voltage at the output even when we apply similar current to the input terminals inverting and non-inverting. I will still see some output voltage in the output output we can measure. The output voltage like how to measure the output voltage, we have we can measure the voltage here um.

So, to make it 0, what to make it 0 output voltage, right. The 2 input currents are made deferred to by small amount this difference is nothing but the input offset current. So, the point that we have to remember is, when we apply equal DC currents to the input voltage to both the input voltage, right? What are input voltage? Is inverting and non-inverting.

Then output voltage should be 0 vo should be 0, but in reality, this is not 0. So, what we can do? We can differ the input current by small amount. If we differ the input current by small amount, the output voltage will become 0. Now this is what we want why we want equal to 0, because we are not applying any voltage, we are we apply equal current then output should be 0, right. Now these are we are balancing our amplifier it is very important, that you balance your operation amplifier before you start working on different kind of circuits, all right.

So, let us see now on the breadboard, how we can connect this and how we can measure the input offset current all right. So, for this again we go back to we go to the the this particular table, right.

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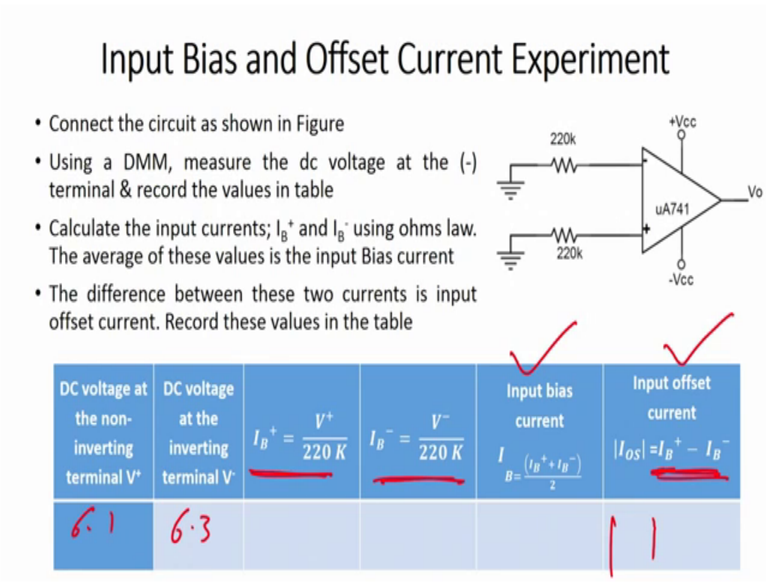

And here what we are we are looking at input offset current, if you remember, we have in the last module we have seen input bias current. Here we are looking at input offset current. Input offset current is I b plus minus I b minus, right. The input by bias current at the non-inverting terminal minus input bias current at the inverting terminal. Now we already know input bias current how we can calculate, right how you can calculate?

So, let us see once again if we connect it. So, there is a breadboard here, again you can see the breadboard right.

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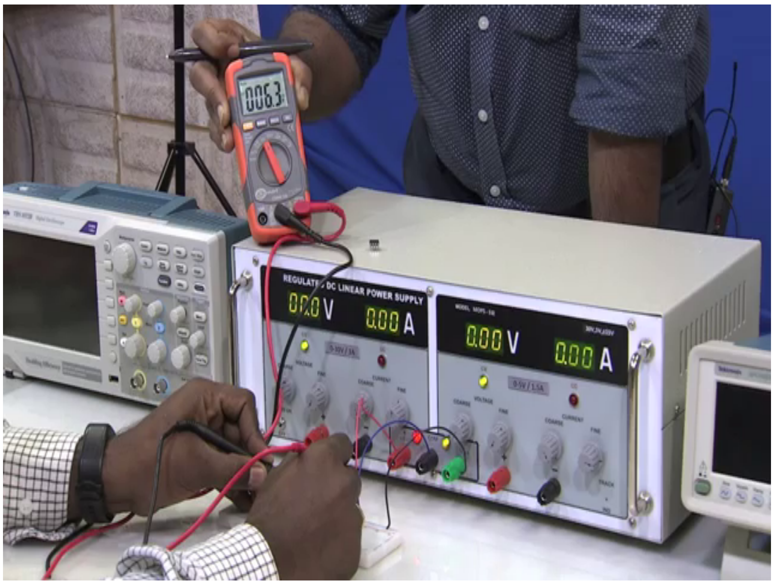

So, here what is there? There is a integrated circuit which is your operational amplifier and there are 2 resistors 220 k, right. This 220 k these resistors are there.

Now, we have applied the bias voltage to the operation amplifier. How we apply bias voltage by applying plus 15, right minus 15 across the across the 7 and 4, right, 7 plus Vcc 4 minus Vcc or or Vee. Now inverting we have to measure voltage at inverting terminal we have to measure voltage at non-inverting terminal.

So, let us see we got the multimeter which you also you have seen in the last module, right this multimeter. And we have measure a lot of things using this multimeter. So, let us see what is the value of in this multimeter. So, can you please check the voltage at the inverting terminal, yeah. So, the value is 6 millivolts, 6.1 millivolts 6.1 millivolts, all right. This is at inverting terminal let us see at non-inverting terminal, 6 point, it depends how you connect it your hands should be stable. 6.3 millivolts good all right so, 6.1 and 6.3 we get 2 values, right.

So, let us write this 6.1 and 6.3 in our table. So, if you see the table, your values are 6.1 and 6.3, 6.3, 6.1 using this value can you calculate I b plus I b minus, yes. Once you calculate I b plus I b minus, you have to take the difference of I b plus and I b minus, and then again you see some mode some mode. So, this is how you can calculate the input offset current, right easy.

But let us see, if I give you an example, if I give you an example theoretical example. For example, you say that Hardik, I cannot I cannot get the values, because I do not have the operational amplifiers. I do not have the DC power supply, I I do not have the measurement systems like multimeter, can I still calculate the input offset current? Can I still calculate input bias current, right? So, theoretically you can theoretical you can.

So, for that let me give you an example, all right so, if we focus on screen.

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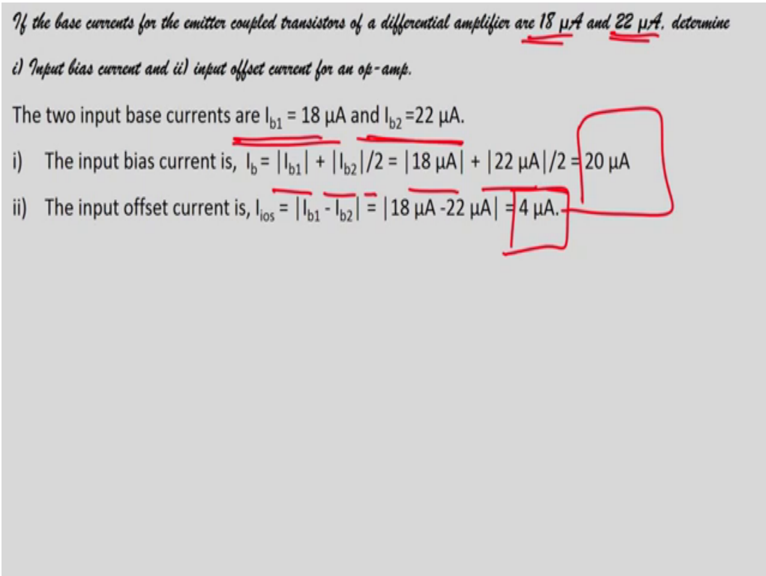

This is an example, what is the example? That if the base current for the emitter coupled transistors of a differential amplifiers are 18 micro ampere and 22 micro ampere. We have got 2 values determined one, input bias current and 2 input offset current for the operation amplifier. So, given the values of I b 1 which is 18 microampere, I b 2 22 microampere. Can you now calculate input bias current input offset current? Is it easy or not? Extremely easy, right? Because that we know the formula.

So, let us see the first one which is input bias current, right. I will give you the answer the input bias current is nothing but I b equals to mode of I b 1 plus I b 2 divided by 218 plus 22 divided by 2 we get answer 20 microampere, super easy, super easy, right?

Now, let us see the second one which is your input offset current for an operational amplifier. So, for that input offset current everybody knows what is the formula? I b equals 2 mode of I b 1 minus I b 2, right. If we put this value again 18 minus 22 would be 4 again it is a mode. So, not minus 4 microampere, do not get this value. It is wrong right so, mode so, it will be even 18 minus 22 is minus 4 it is a mode. So, we get a value for microampere, easy?

So, this is how you can calculate the values even at home, right. Take a problem and solve it, right. Solve as many problems as you can, then go to the laboratory or get the multimeter at home a small multimeter a DC power supply, right. and you can have a small lab at home. You do not really required to go to the university go to the college and learn something, right. You can learn from anywhere, any place, that is the idea of the learning, right. Learning is not restricted to a particular building, learning is not restricted to a particular lab, learning is not restricted to a particular college, learning is not restricted to particular university, learning is not restricted to any books also, right?

Learning can be done anywhere if you want to learn. And this is the way you go and learn use internet, right. Take the nptel courses learn, right. Understand and then out of your curiosity ask questions. You before you ask questions, you should try to answer this question by yourself, try to see, right? Do not rely on spoon feeding, that is always my one sentence, I tell you again and again, do not rely on spoon feeding, right? So, we this is how we can measure the input offset current, and we can measure the input bias current. So, in the next module we will see another experiment, or another characteristics of an operational amplifier.

Thank you.