

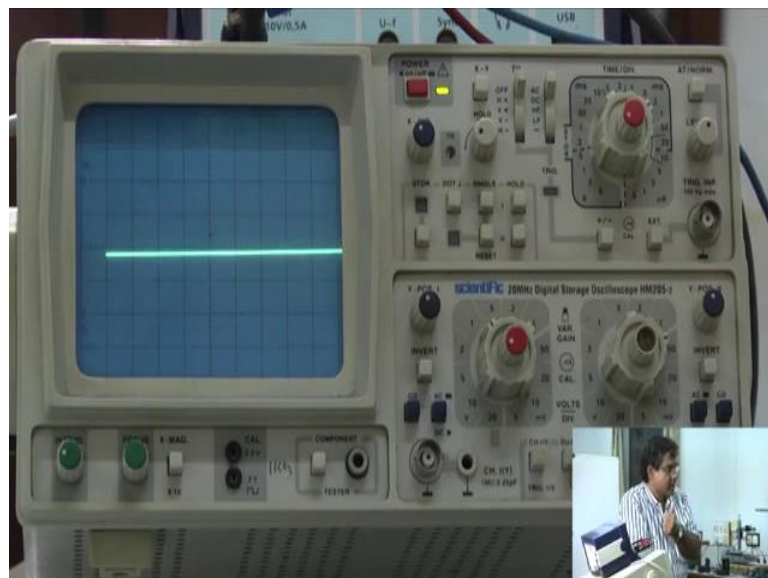
Experimental Physics - III
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Lecture - 01
Basic Tools and Instruments in the Laboratory

See you are welcome to Experimental Physics III, earlier I have discussed about the experimental physics I and experimental physics II. in experimental physics III mainly I will demonstrate experiments on solid state physics and modern physics, where some experiments on atomic physics, some experiments on quantum physics, some experiment on molecular physics. this I will discuss in this module III.

today in this first lecture I will I would like to tell you about the basic tools and instruments in laboratory. Basically, for solid state laboratory and this modern optics laboratory what are the common instruments, what are the common tools we use for performing the experiment that I will discuss, but I will it is not possible to cover in 1 class. few lectures I need to cover them. in laboratory when will go if basic 1 instrument is that is Cathode Ray Oscilloscope, CRO.

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the here you can see this CRO all of you are quite familiar with this instrument. today I will discuss about the function of different knobs on front panel of the CRO that I would like to tell you about this function of the different knobs. And, then also what I have

what is the use of this CRO there are many many purpose for using the CRO ellaboratory, but I will mention few of them, what I really use in research laboratory as well as in teaching laboratory. But, it is not the only the use of the CRO is not limited in this few application, but there are many others applications.

Then, I will discuss other basic instruments in laboratory there is say how to produce magnetic field in laboratory. How to produce electric field in laboratory? How to major magnetic field? How to major electric field? How to measure the temperature? Because, the experiments will perform in the laboratory, in this experimental physics III, there we will study some property of material as a function of temperature as a function of magnetic field, as a function of electric field, ok.

there when we will discuss about the experiment, if different we know about the basic requirement for those experiments like, magnetic field, electric field, temperature, then this CRO cathodic tube. And, another very important instrument basic instruments in laboratory is there that is lockin amplifier, your quite familiar with the amplifier. we use to amplify the signal, but lockin amplifier that is very important instruments in laboratory to detect the very weak, signal from the noise you are signal is very weak, even it is weaker than the noise. how to extract that signal from the noise accurately?

for that purpose we use lockin amplifier. I will discuss about the lockin amplifier also. I need few classes, few lectures to cover all these things. today let us concentrate to discuss about the cathode ray tube oscilloscope, this is very common instrument you have seen you have used also you may know everything, ok. But, let me just remind you the use of different knobs of the oscilloscope. that you confidently you can use in laboratory. so this; here let me just switch on the what are the knobs one first this is the power on or off red button?

let me push this one. now, it is showing this power is on and here on the screen this is the you know this is actually in experimental physics 1, I have discussed about the CRT, ok. What are the internal component of the CRO I have discussed? today actually I will not discuss about that much, today I will concentrate myself to how to use the form panel of the CRO for different application. that I would like to tell you.

here on the screen, on the screen, you are seeing a line, you are seeing a line. this you move this from CRT from cathode ray tube, the electron beams are coming and falling on the screen.

here this electron beam now, falling on the screen. while it is falling that place is a phosphorus screen, phosphor screen. there will be illumination on that point. here you are seeing line means electrons is falling on along this line. here you know this X deflection and Y deflection 2 sets of deflecting plates are there. that deflecting plate here for X and for y. here you can see this X position, if I just move this one. I can change the X position of the electrons falling on the screen, ok.

when I am rotating this knob means I am changing the voltage to the deflecting plate X plate ok, this is the capacitor plate 2 plate, ok. voltage is applied now electric field is produced. this electron beam is passing through this between these 2 plates, where it is passing, then there will be force on these electrons due to the electric field. that electric field, I can change and this then force will change and it will move from it will shift depending on the direction of the field.

here I am changing the voltage of the deflecting plate, Similarly, Y position, ok; here the Y plate the deflection plates their voltage I am changing this. so far X plate and Y plate, X position Y positions that you can change using this, ok.

here let me this is the intensity knob ok, this is the focusing knob, here I am seeing this X magnitude, ok. below is multiplied with 10. this let me tell one after another; intensity you can just depending on your requirement just you can change the intensity here. here changing the intensity just rotating knob what you are doing?

internally this intensity is increased or decreased means, either number of electrons are coming, I think numbers of electrons are coming from the screen that is more, then intensity will be higher, it is less then it will be lower. here somewhere you are changing the voltage, I think big voltage or some p acceleration voltage there your increasing or decreasing.

thus you are controlling the number of electrons falling on the screen, that also it can be at last I do not know exactly, but it can be also one can control the filament current ok.

this is the number of electron should be higher, when we are we want higher intensity and vice versa, ok. this is the intensity knob.

when we are rotating this one, what is happening inside that also I think you should understand, because I have discussed about the internal component. externally this knob we use for changing the intensity of the beam. Now, if this beam is we can focus it you see. Now is we have to we can make it very sharp ok. focusing knob, they are this lens are there electrostatic lenses are there in the tube.

that we are from this using this knob we are changing the voltage, we are changing the electric field in that circuit electrostatic lens in that circuit we have changing some voltage or corresponding electric field. So this is the intensity knob ok, yeah focusing knob.

This another knob there are you see in this CRO there are some knobs, but in other CRO that knobs are not their different type knobs are there, ok. but main knobs are I have let me discuss just main knobs and use of them ok. Here some magnification itself it is there, but in other oscilloscope this knob is not there ok. What is the function of that I can tell, but let not me, not discuss about the uncommon of knobs now then will be deviated from our main aim?

here; CRO the use of CRO first we see this we can measure the voltage as well as, even current also you can measure voltage current and the frequency of a AC signal. If, it is DC signal we can measure the voltage corresponding current also one can measure ok, current voltage and frequency mainly this three we can measure using the CRO for any signal. I have a signal generator, I have a signal generator, ok.

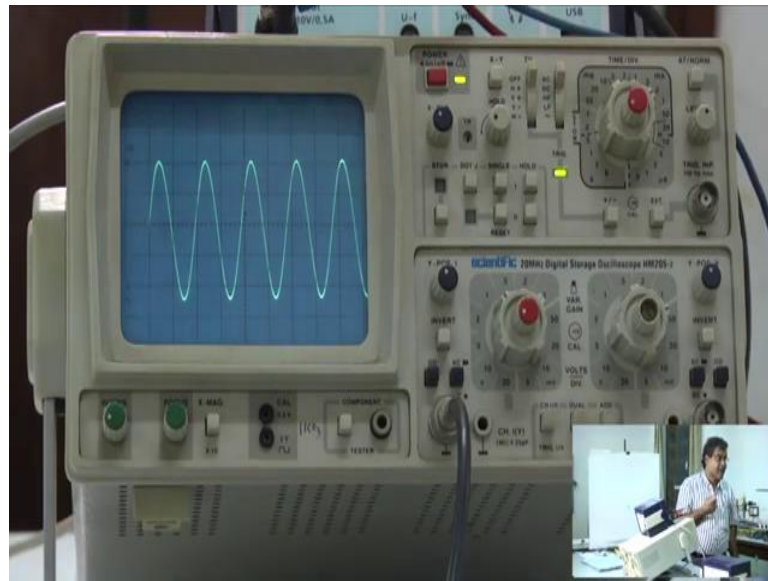
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I can this is the generator it can generate is tell function generator, ok. I can generate depend signal, this of sin function of different functions basically. this it can be sinusoidal signal, it can be short width signal, it can be square waves, ok. different kind of signal we can generate from this generator and also we can get different amplitude as well as different frequency of that signal. here one here this is a showing that 5 kilo Hertz and 5-volt peak to peak 5 volts, and, DC part here 0 and this is the sinusoidal signal.

here options are there you can get other signal also as I told short width triangular signal, triangular square, ok. let us not discuss out the signal generator I need a signal. I am taking a signal; now, I want to measure the, I want to measure the voltage time float or the frequency of the signal etcetera, ok. CRO I have to use for that purpose or we use for that purpose, ok.

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here you are seeing this signal is coming and I put in this channel is the channel 1 is the dual beam oscilloscope. it has two channel 1 and channel 2 ok. as I told this I can measure the voltage peak to peak voltage of the signal as well as I can measure the frequency of the signal. here as I told the X and Y; this is the X axis and this is the Y axis. here this voltage is varying along the Y axis, along the Y axis voltage is varying of the signal amplitude voltage in amplitude amplitude in volt.

that I should be able to measure using the oscilloscope means this along the Y direction the divisions you are seeing that is the basically, that scale is in volt, ok. now, that scale along the Y axis that scale, I can change that scale, ok. for that this is the knob here this whatever the reading is written, you can see this is here it is written V volt; V volt, I think this V volt 20, 10 5 2 1 0.5, 0.2, 0.3, ok. Then, this here now 50 it is in mille volt ok. this is the 50 mille volt, 20 mille volt, 10 milli volt ok, 5 milli volt, ok.

you can choose the scale changing this knob, ok. I have put here at one. what does it mean? Say, here this bigger division you are seeing this is each division is 1 volt. now, in your signal peak to peak the value, how much what is the value that you want to find out. just let me take as coincide the yes this they are peak at this horizontal line along this horizontal line.

1, 2, 3, 4; 1, 2, 3, 4 and this is more or less 0.5. this peak to peak volt here it is showing it is a 0.4 0.5 volt, while here I have kept it at 1 volt per division, ok. I will tell this is the signal is having the signal is having the peak to peak amplitude that is 4.5 volt.

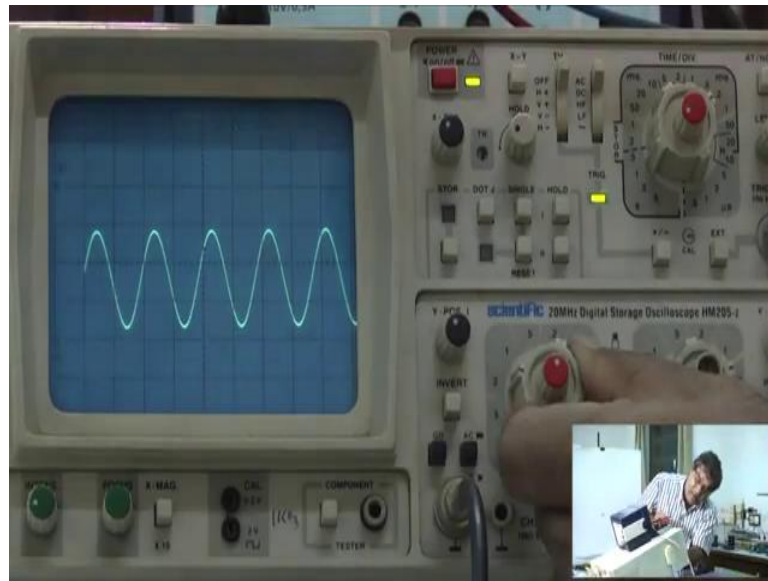
But, this signal generator it is telling it is telling this is 5 peak to peak 5 volts, but my CRO it is giving me value that 4.5 volt. for unknown signal, if I want to measure the amplitude it will give that that reading will be wrong. here I came to know that reading is wrong, because the either this function generator is wrong or this something wrong in the CRO. There it is telling it is 5-volt peak to peak value, but my CRO my measurement is telling it is 4.5 volt.

it should not be the case, because yeah it may not be exactly same, but there will be error, but it should, cannot be that much different, ok. that is why that here this options are there you know this cal. CRO you can calibrate here it is a written cal from here you can take. it is giving 0.2 volt, it is the giving 0.2 volt and this below 1 is giving 2 volts this I think this square signal is the square signal of 0.2 volt and 2 volts.

So my CRO past one should calibrate taking that signal from here put as an input to the CRO you check it ok, whether calibration is correct or not. actually there is a calibration knob here you know. I do not know this calibration knob (Refer Time: 21:24) calibration knob, if you turned maximum to the left you see it changing, while I am rotating this one, but it is 1 volt, it is 1 volt per division, but when I am changing this one it is a changing, but my signal is the 5 volt.

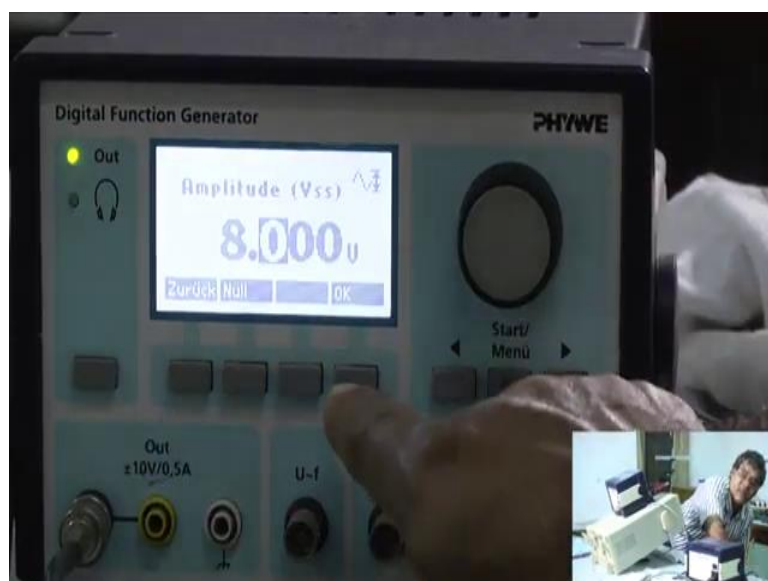
calibration is not being in correct way. I think what happens this should be here, I do not know exactly it may be the case let make it 5 ok, let me make it 5 and then I will tell you sometimes I have to I am let me check this is one it is a slightly, I have to reduce slightly. I think this is the yes slightly more or yes. Now, I can see 1 2 3 4 5 divisions, ok. it is the 1, it is the, this knob is at 1 1 volts per division in that scale.

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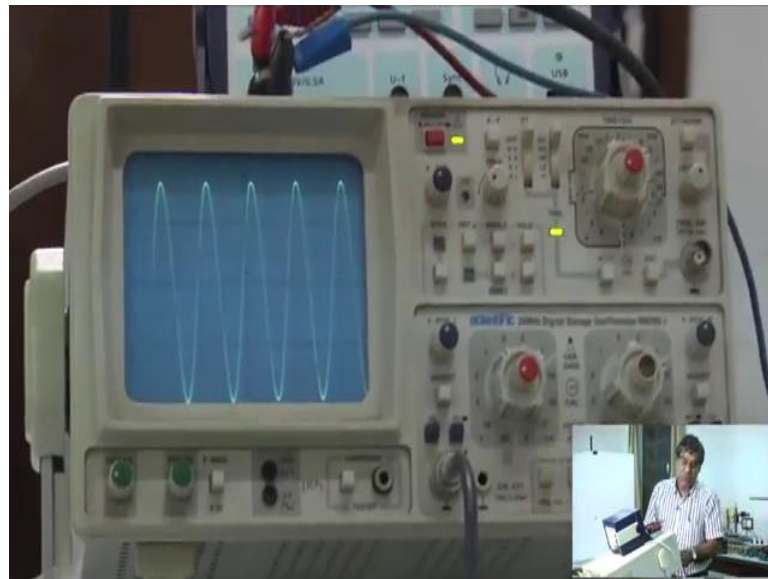
see if I keep it here then it is giving me the correct value. this is the 2.5 division. this 5 volt is the one division more or less it is the one slightly more; this knob, if I rotate if I change the calibration changes. now, really tell if it completely if we rotate at the towards the left and just it is making one noise is just means it got stuck there. then really tells that is a now it is the calibrate one ok. If, it is calibrated 1 in this condition, but then it should be I think, 1 2 3 4 4.5 again it is showing 4.5-volt peak to peak 1 2 3 4 4.5 or slightly more. But, let me take another voltage here, I think just I will change the voltage here signal this is the amplitude.

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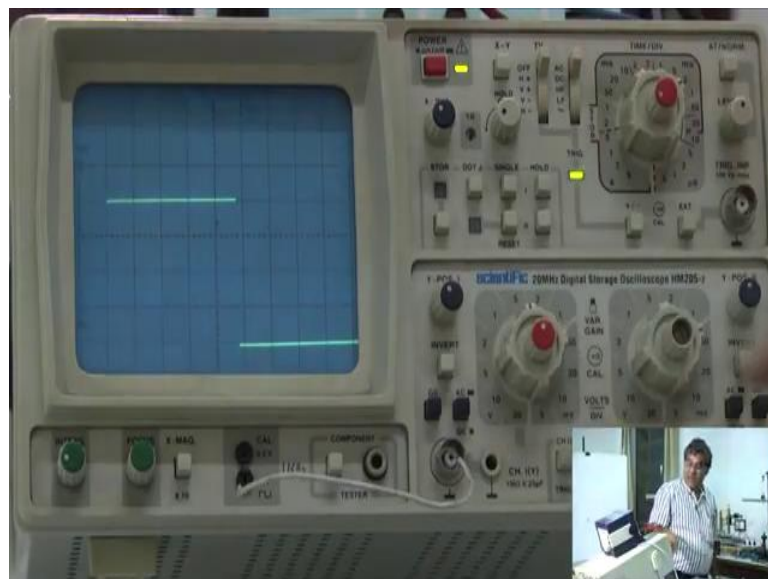
Now, I am taking different amplitude say 6 or 8 it is now 8 ok, 8.

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for 8 you see, where 1 2 3 4 5 6 7, now it is coming 7.5. I think this 0.5 some offset something some units there, ok. so better whether this is correct or that other one is correct that I am not sure. that is why really it we should do calibration using this we should take the calibration, see you remove it, we remove it.

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And, if I take 2 volts from as a signal from here and I put signal here ok, you see as I told that you will get the square wave. here it should be 2 volt let me check whether it is 2

volts. See, it is 1 2 yes more or less it is 2 volts ok, it is 2 volts 2 division, see it is at if I 0.5. it should be in fourth division 1 2 3 4 yeah more or less I think it is the.

it is a slightly it is not giving. there is some problem with this one I think it should be it is calibration knob is not working properly. it should be 1 2 3 4, I will put here then they see yes. Now, this it is now fourth division I have put 0.5. This per division it is 4 it is 2 volts. So this, my signal here now, it is calibrated 1, ok. now, I think I will stop next class so.

Thank you.