Hello students.

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Today we'll be doing Unit 3: Signal Conditioning and the

module name is basics of instrumentation amplifier,

instrumentation system. The module number is 19.

The outline of the module is Instrumentation amplifier,

Schematic of an instrumentation amplifier,

an Instrumentation system.

Through this module, the students will be able to explain the

working of an instrumentation amplifier, Design and construct

an instrumentation system.

Let us begin with our module.

An instrumentation amplifier amplifies low level signal

output of an electrical transducers before any further

processing. So when you have to select an instrumentation

amplifiers, there are important features. The first

one: Selectable gain with high gain accuracy and high gain

linearity. Differential input capability with high gain

common mode rejection.

3rd: High stability of gain with low temperature coefficient.

4th: Load DC offset and drift errors, which is referred to the

input. And finally low output impedance.

So the diagram what you see over here is the

circuit for an instrumentation op amp. So

basically you require three op amps.

So over here we have A1 and A2 which is called as the input

buffer and it has a unity gain for common mode signals.

And the gain is 1 + 2 times the value of R2 / R1 for differential signals.

Now E1 plus Ecm is the voltage applied to the A1

amplifier. An E2 plus Ecm is the input voltage applied to

the A2 amplifier.

Now this particular opamp A3 is called as

a difference amplifier and the gain is chosen in such a way

depending on the values of R4 R5 R6 and R7.

We shall look into details.

So let us assume that the value of R4 R5 R6 and

R7 are the same.

So now we need to know what is the voltage at E3 and what is

the voltage at E4.

So over here, if you want to know what is the voltage at E3,

It is because of two reasons: it is because of the voltage E1

and Ecm and also because of the voltage of E2 plus Ecm.

So over here, the first thing

is If you look at this particular op amp A1 it is a

non inverting amplifier and A2 also is a non inverting

amplifier. The gain of a noninverting amplifier is given as

Av is equal to 1 plus RF upon R1. So RF is your feedback

resistor, so in this case R2 is your feedback resistor

for A1 and R3 is your feedback resistor for A2.

And your input resistor will be

R1. Now, If it was a inverting amplifier, the gain of

inverting amplifiers given as Av is equal to minus RF upon R1

, so therefore your voltage at E3 will be equal to 1 +

R2 divided by R1 multiplied by the input voltage i.e E1.

Minus R2

upon R1 into Ecm plus E2. now why this voltage is

occurring in this particular equation is because.

When this particular voltages is there due to virtual ground, the

same potential is there across the inverting terminal and

therefore this voltage is also applied through R1. So

similarly the voltage at E4 will be written as E4 is equal to 1

+ R3 divided by R1 multiplied by E2. This is

because of the voltage applied to the second of op amp minus

R3 upon R1 into Ecm plus

E1. ECM is the common mode voltage, so it can be noise or

it can be at any common voltage which is present at both

the inputs. So finally

if the value of R2 and R3 are the same and it is very very

important that the values of R2 And R3 are the same.

You take the difference of E4 and E3. So E4, when you take

subtraction of E4 and E3, the output voltage will be given as

1 + 2 times the value of R2 divided by R1 into E2 minus E1.

So after solving this. i.e E4 - E3 there are some

terms will be cancel out i.e. Ecm and Ecm will be cancelled out and

other terms will be

Added, so this particular voltage, that is E0 will be

produced if and only if the values of R4 R5 R6 and R7 are the same.

It is called as unity differential amplifier. But if

The values of R4 and R5 are different, that is ill take an

example if R4 and R6 are the same like for 1K ohm an R5 and

R7 is the same 10 K ohm. Keep this in mind the gain is

10. So whatever is the difference between E4 minus E3

this voltage will be amplified 10 times at the

output. So the gain of the instrumentation amplifier can be

varied by just changing the value of R1, so this entire

construction. What you have seen over here, it consists of three

op amps. The 1st two op amps are called as a unity buffer

opamp. The Third Opamp is called as a differential

amplifier, so you can use OP 07 or you can use 741 IC to

construct an instrumentation op amp, so this is what is present

in an Instrumentation op amp

Now coming up, the next topic is an instrumentation system.

The measurement and control of physical condition is very

important in many industrial and consumer applications.

It is very important to measure the output signal produced by

the transducer and also it is mere important to control the

physical condition by producing the output signal.

An automatic process controller is used at the output stage to

compensate for the changes in the operating condition.

Now this is the block diagram of the instrumentation system. It consists

of three stages. The first stage is called as the input stage.

The second stage is called as the intermediate stage and the

third one is called as the output stage, which is having

output amplifier. So the physical quantity to be measured is going to be sensed by your input stage, which is consisting of a transducer and preamplifier. So a transducer will convert the physical quantity into an electrical form. It can be in terms of current or it can be in the form of voltage. So this particular signal is supplied to the intermediate stage. So what you see over here is a transmission lines. So whenever input stage is connected to the intermediate stage, you need transmission wires to transfer signal for one point to the other point. The Function of the intermediate stages it requires to amplify the low level Signals, now why do we need to amplify low level signals because in order to produce an output you need to produce it on the indicating device. It can be on a meter or it can be on a digital display. So the signal has to be modified so that it can be displayed on the output.

Now, This entire thing What Have you seen is very very Important in making an instrumentation system.

These are my references and with this we come to the end of the module. Thank you.