Hello, this is Principles of Engineering System unit, learning outcome 8, analysing system responses.

Here we have an underdamped response or oscillating response; it goes up and then it settles off.

The first thing we can see is that it is not settling at the set point. Where it settles is what we call the steady state, what we now see is that we have a difference in what we want and the response. This is called the steady state error (SSE). So to work it out we do steady state minus the set point. Then go back to the start of the response, there is a gap between zero and the start of the response, this is called the lag time. Then it rises until it gets to the set point, this is called the rise time. We keep going until it reaches the peak, which is at two hundred degrees. Now we can work out the percentage overshoot, it really depends on the value we have here, if we have twenty degrees over smaller number will be different to a larger number, so we talk about percentage overshoot which has more significance. For this example, twenty divided by one hundred and eighty, multiplied by one hundred equals eleven point one percent.

Then we can look at the cycle, because this is an oscillating response it is going up and down, the magnitude is getting less but the frequency is constant. One up and one down, peak and trough gives us a full cycle. So, we can either do peak to peak or trough to trough.

Measure cycle time work out frequency, one divided by time and it is measured in hertz.

The next thing is the settling time, we must work out a percentage of the steady state and in this case two percent of the steady state. Two percent of one hundred and eighty is equal to three point six. So we will have to say three point six above and below. Draw an upper and a lower band at one hundred and eighty three point six, and one hundred and seventy six point four. When the response comes within the band and never goes back out, that is the point where the settling time is measured from.

This has demonstrated analysing one system response, in other cases there may not be a lag time, but it has to be an oscillating response to get all the other parts. All the information taken from the system response could be summarised in a table like this, so two responses can be compared easily. Then statements can be made on the differences between the system responses.

Thank you for listening.