Control System Design
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Lecture – 01
Introduction

Hello, the title of this course is Control System Design. And I am G R Jayanth; I am the instructor of this course; I belong to the department of instrumentation and applied physics at Indian Institute of Science. In this video clip, I shall briefly discuss the scope of this course and outline its technical content. As the title of the course itself indicates, in this course we are interested in control of physical systems. However, this is too broad to be the scope of this course, because one could argue that the goal of all of engineering is to get physical systems to obey our commands or in other words to control them.

However, there are occasions when the systems that we have engineered to obey our command do not exactly obey our command. Either because we do not fully understand its working; in other words there is some uncertainty associated with its dynamics or because there are disturbances in its working environment that prevent it from exactly obeying our command. So, in such a case what is done is to invest in a sensor and measure the output of this physical system that we want to control, and modify the input to the physical system based on the output in such a way that the physical system ultimately ends up obeying our command much better than before and perhaps perfectly if possible.

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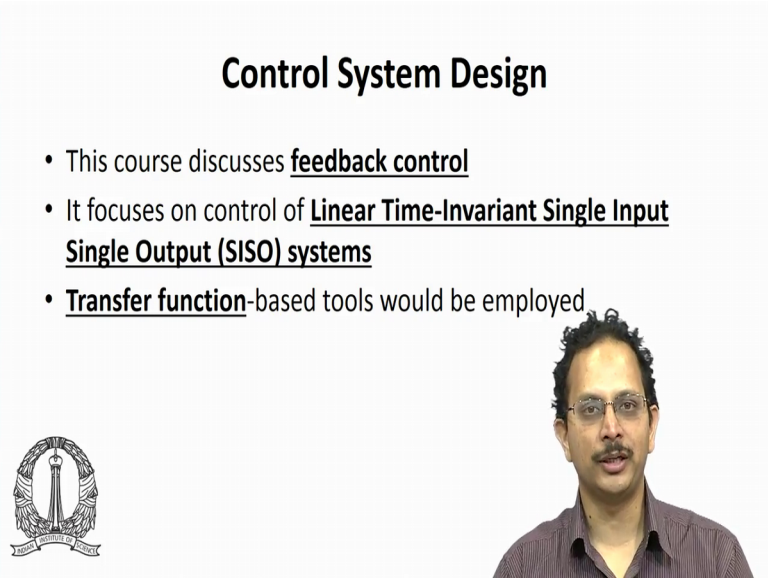

Now, such a technique comes under the ambit of what is known as feedback control. So, in this course, we would restrict ourselves to feedback control of dynamic systems. Now, one might wonder which disciplines would be interested in feedback control theory. To answer this question, I first want to note that feedback control is a cross disciplinary subject which is of interest to a range of engineering disciplines all the way from aerospace engineering to electrical engineering, mechanical engineering, civil engineering and chemical engineering and so on. And also that mathematics is a formal language of feedback control theory.

In other words, what one generally does when one wants to control a physical system which could be in any of these different disciplines is that one first tries to come up with a reasonably good mathematical model for this physical system. Now, once we have this mathematical model, then the control engineer tries to come up with a control law which is another mathematical equation that could tell us how one might modify the input to this physical system. So as to correct for the error between what we commanded it to do and what it is ending up doing due to uncertainties either in its model or in its ambient environment. Now, this control law is usually implemented using an electronic module in combination with a suitable set of actuators.

So, to come back to this question as to which physical systems we are trying to control and who might find this subject interesting, the answer is that all engineers were

interested in controlling their physical systems would find this a useful course, because we are starting with the mathematical models of the systems that they are trying to control.

Here I want to introduce another restriction to the scope of this course. In this course, we would limit ourselves to systems that are linear, time-invariant and have a single input and a single output. So, control of linear time-invariant, single input single output systems would what would comprise the vast majority of the lectures that would be delivered in this course. There are two strategies that are generally employed to control such systems; one is in the time domain and other is in the frequency domain where one employs the notion of a transfer function. So, the third restriction on the scope is that this course would focus primarily on transfer function based tools and all control system design and analysis would be performed in the complex plane.

So, with this brief preamble on the scope of this course, I shall now discuss about its technical content. This course is targeted primarily at students who have already had one beginner's course in control systems in their undergraduate education. Therefore, perhaps students in their third year or fourth year of undergraduate education and above including master and Ph.D., students should be able to follow this course content without any difficulty.