Introduction to Materials Science and Engineering
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Lecture - 01
Introduction

Welcome to this course. Here is our bicycle.

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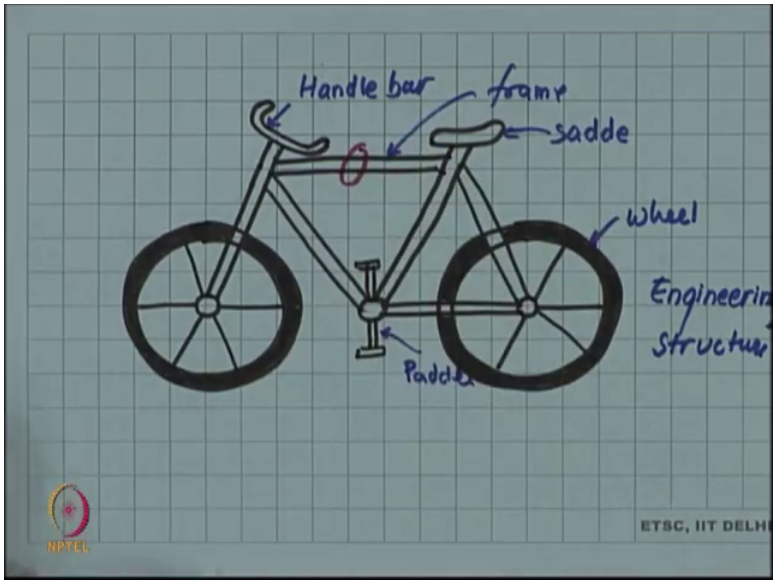

And this bicycle is an engineering structure made up of several components. So, there is this handlebar, we have this frame, saddle, wheel paddle and so on. So, this is designed for a particular function, and this can be our example of an engineering structure. Each of the components are made up of certain material, and its engineers responsibility to select suitable material for each of these components. If we now look at one particular component, this frame for example. So, the frame is made of a mild steel tube.

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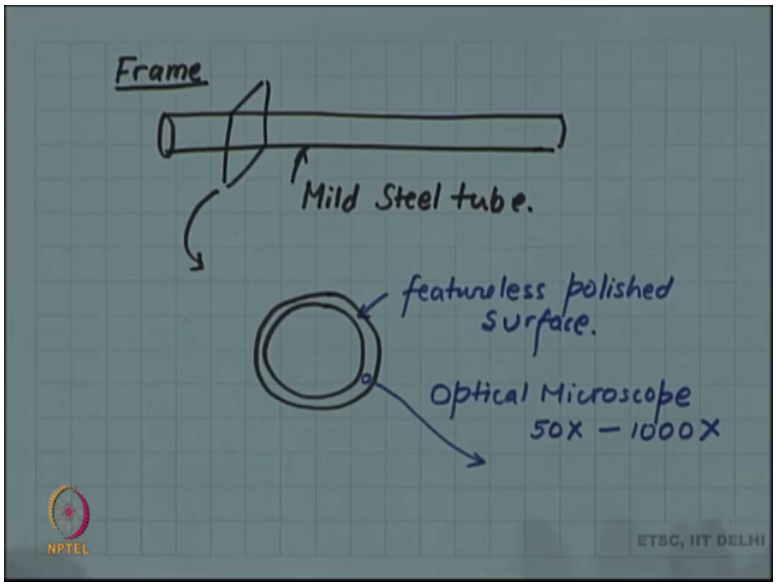

We are now looking at frame tube in more detail. So, it is a mild steel tube. If we cut this tube and look at the cross section, then we will see in general a featureless cross section, we can polish this, and we will have a nice shining featureless surface, but then if we look at a small region of this featureless surface at higher magnification using. Let us say an optical microscope, let us magnify this in an optical microscope which has magnification, let us say from 50 times to about 1000 times, then we will see a whole new world inside this. Let me try to draw any schematic of what we will expect if we see that mild steel tube properly prepared at higher magnification.

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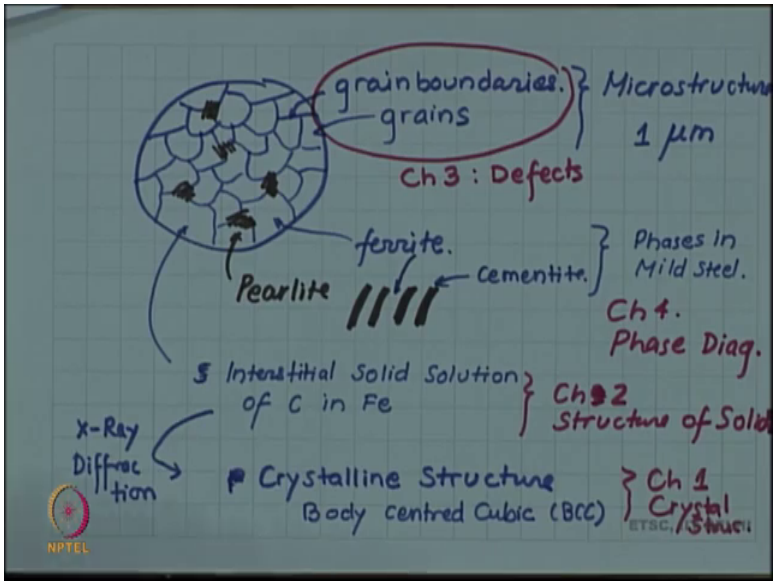

So, we will then start seeing what was featureless before and the magnification of naked eye at higher magnification. It will now start showing certain features. These regions are called grains and the lines are called grain boundaries. These features are coming by looking at the structure through an optical microscope, they are called micro structure. So, grain boundaries and grains are features of a micro structure, the scale of micro structure is about.

Let us say microns; that is where the micrometer comes from. So, we will talk about grains and grain boundaries. The meaning of these terms will become clear as we go along in the course, and grains and grain boundaries we will discuss in chapter 3 of this course, which deals with defects in crystalline structure.

In fact, they are not only these grains and grain boundaries in certain regions, there are some dark patches also which we will call pearlite, and these lighter regions which we called grains where the ferrite and pearlite looked at in detail, is again can be seen to be alternate bands of dark and white region, in which the lighter regions are ferrite and the darker regions are cementite. Ferrite and cementite are the, so called phases in mild steel.

We will learn about these phases. And in the topic called phase diagram which is our chapter 4. Now if we wish to look at it in little bit more detail about these grains of ferrite, then we will find out that these grains of ferrite are actually solid solutions. To be more precise interstitial solid solutions, interstitial solid solutions, solid solution of carbon in iron, we will talk about such a structure, such alloy structure solid solution, interstitial solid solution is one kind, substitutional is another kind. These things will be discussed in a structure of solids chapter 3. Sorry chapter 2. Finally, if we want to go in a still more detail and look at what this solid solution, how the atoms are arranged inside the solid solution.

We have to use technique like x ray diffraction. If we use x ray diffraction it will tell us that this solid solution actually has a structure of body centred cubic. So, it has a crystalline structure, it has a crystalline structure and the crystal structure is body centred cubic B C C. We will talk in detail about crystal and crystal structure in our chapter 1, and we will be beginning with this chapter in the next video, but before we do that

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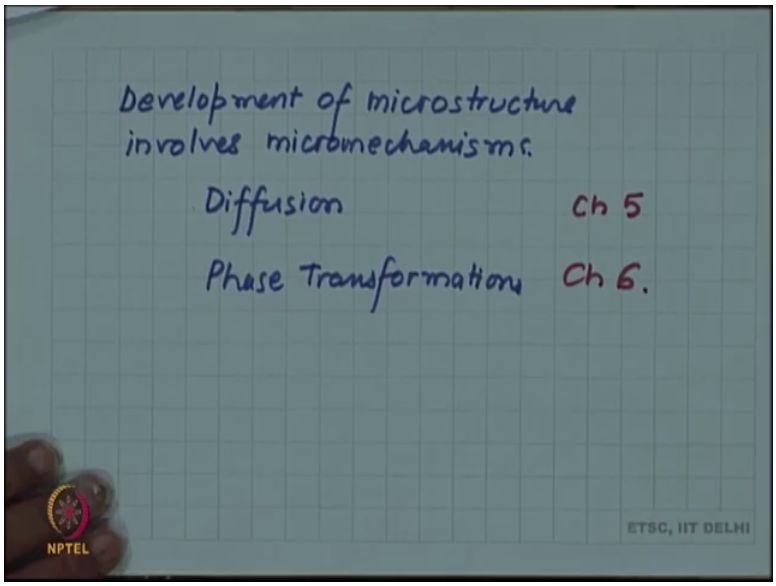

Let us look at other parts of the course. We looked at the micro mechanism of the development of micro structure involves micro mechanisms; such as diffusion and phase transformations. So, both of these will be important topics in our course. Diffusion will be our chapter 5, and phase transformation will be chapter 6.

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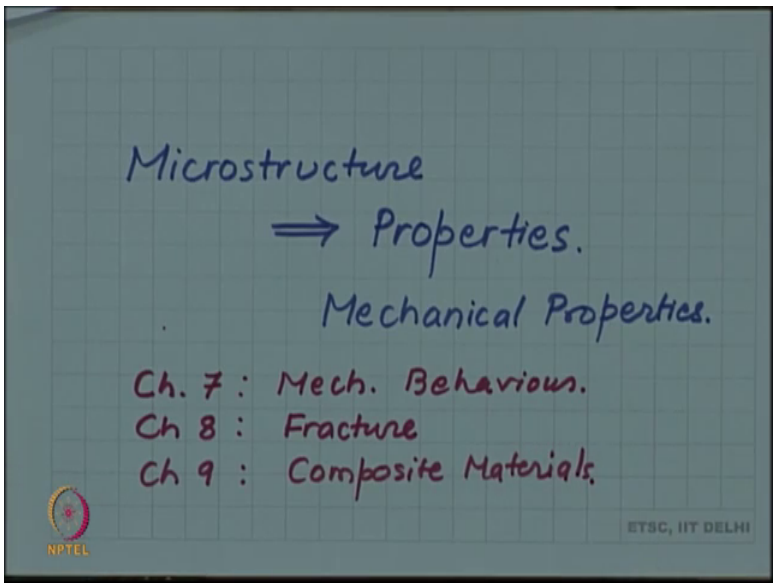

The microstructure which determines properties, and for us the important property in this course which we are going to talk about, is the mechanical property. This topic will come in chapter 7 on mechanical behaviour. And finally, in chapter 8 we will see how

ultimately materials fails or breaks; that is fracture. And if you are interested in spending more for your bicycle and are not satisfied with the traditional mild steel frame you can go for lighter, but more expensive bicycles made of composite frame. So, chapter 9, the final chapter of this course, we will then talk of composite materials. So, with this introduction, we will now go on to a study crystal structure in reasonable detail in from a starting from the next video see you.