Welcome dear students.

Today's lecture is for first year B.Sc chemistry semester I.

The paper code is CHC101, paper title Inorganic chemistry and Organic chemistry.

In this module we are going to study about the concept of chirality. The outline of this module would be; First, we're going to understand the concept of chiral and achiral molecules; and then identify some of the chiral centres in a molecule.

At the end of this module, you'll be able to understand the concept of chirality, identify chiral centres and analyse chirality of a molecule.

To understand chirality, let's take a life experience. When we stand in front of a mirror, we see ourselves reflected into the mirror; the image what we see is known as the mirror image, which is the reflection of an object in a mirror. Now this mirror image can be superimposable mirror image or non-superimposable mirror image.

Superimposable Mirror image is that image which coincides at all points when the images are laid upon each other. Whereas non-superimposable mirror images are those images, where not all points coincide when the image are laid upon each other. Let's take a few examples to understand this concept. In the first example we see an image of a hand and when we place a mirror in front of that image, we see that there is a mirror image or a reflection of that image. When we try to superimpose this mirror image, we see that all the points don't coincide with each other; hence this image is non superimposable mirror image. Whereas when we take another example of letter X and we place a mirror and we get a mirror image of it, we tried to superimpose this image on its mirror image and we see that all the points coincide with each other, So such images called as Superimposable Mirror image.

Coming to the concept of chirality. Chiral objects are those objects which is non superimposable on its mirror image. For example, this hand.

We have seen that when we try to coincide this mirror images, we see that all the points don't coincide, hence, such object is called as chiral object.

Whereas when we see the example of this letter X, we try to coincide them with each other. We see that all the points coincide with its mirror image. Therefore, such objects are called as achiral objects.

Let us take few more example. Here you see a question mark which is reflected with the help of this mirror and we try to superimpose it, since it is not superimposable. It is a chiral object. Similarly, we see this letter P, once we coincide it with its mirror image, it does not coincide with all its points therefore. It is a chiral image.

Then if you see this example of a glass, if you take a mirror image of this glass and we try to coincide with the images, we see that all the points are coinciding with each other. Therefore, such objects are called as achiral objects.

Let's extend this concept to chemistry. In organic compounds we have lot of stereoisomers, those stereoisomers that are not superimposable on their mirror images are called as chiral molecules.
The word chiral comes from the Greek word, which means hand. So, we have seen that, the mirror image of the hand can't be superimposed on each other. Therefore, chirality also means handedness. So here in this molecule we see that, a carbon atom. If we label this as a carbon atom and the other atoms as substituents, this different colors represent different substituents. If we take a mirror image of this
particular molecule, and if we try to superimpose it, we see that, it is nonsuperimposable. Hence this
molecule is a chiral molecule.

In this example we see this carbon atom has chlorine, iodine, bromine and hydrogen as it substituents. If we place a mirror and take a mirror image of this particular molecule, we see that this particular molecule, even if we try to superimpose on each other the images, it won't get superimposed. Even if you try to rotate this molecule by 180 degrees; you'll still see that after all rotations, you can't superimpose the mirror image on the original image. Hence. Such molecule is a chiral molecule.

The most common cause of chirality is the presence of chiral centre. Now chiral centre is an atom with four different groups bonded to it. Usually, chirality is designated with an

asterick sign, as you can see here. So, this carbon has four different substituents, hence this carbon is a chiral center.

Let's take another example of a molecule. In this molecule you see that both this substituents CH_3 are same. If we place a mirror, we take a mirror image of this molecule. You'll see that, after rotation, although this image doesn't look to superimpose each other, you see that after rotation of 120 degrees
around C-OH bond, you get a molecule which can be superimposed on the original molecule. Hence such
molecules are achiral molecules.

Another important point to notice achiral object has at least one plane of symmetry. In this molecule which I have returned differently, you see that there's a plane of symmetry. If you divide this molecule there is a plane of symmetry here. Hence, this molecule is achiral.

Let's take a few examples and identify the chiral centres. In this first molecule, we can see that carbon is bonded to four different groups 1, 2, 3 and 4. Therefore, this carbon is a chiral centre.

Similarly, if you see here this carbon has 3 hydrogens which are same substituents. Therefore, this won't be a chiral centre. But if you see here, this carbon has four different substitutes, therefore this is a chiral
Centre. Further, this carbon has 2 hydrogens, therefore it can't be a chiral centre. This molecule has only one chiral centre.

Coming to the next molecule you can see here that. This molecule has two chiral centres. If you see there are four different substance 1,2,3 and the remaining part is a fourth substituent similarly to the second carbon.

In the next molecule also, you can see two chiral centres. The presence of a single chiral centre in a molecule guarantees that the molecule is chiral. But the presence of two or more chiral centres may or may not result in the molecule being chiral. When we had seen the last example, we had noted that there are two chiral centres here, so this molecule, if you see the stereoisomer of this particular molecule, this

stereoisomer. You can have a plane of symmetry or internal plane of symmetry within this molecule. Therefore, this molecule is achiral, whereas if you see the second stereoisomer. You see, there is no internal plane of symmetry, so there is no internal plane of symmetry which divides the molecule, hence, this molecule is chiral.

To summarize. In this module we have studied the concept of chirality. We have identified chiral centres in molecule and we have cited few examples of chiral compounds.

These are some of the references.

Thank you.