Symmetry, Stereochemistry and Applications
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Module No # 05
Lecture No # 29
Diastereomerism in Pi System

Welcome back to the course entitled symmetry, stereochemistry and applications, so in the previous lectures we were discussing about diastereomerism in the cyclic systems. In this current lecture we will discuss about the diastereomerism in Pi systems.

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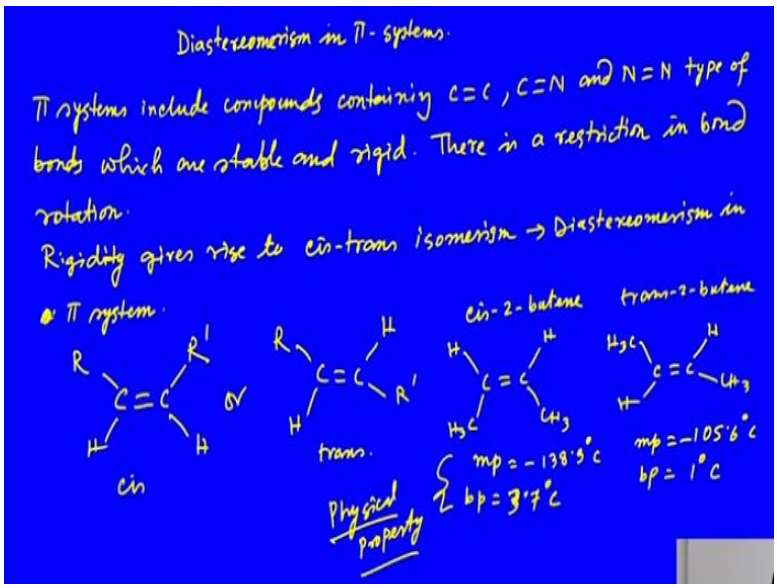

So the Pi systems include compounds containing C double bond C, C double bond N and N double bond N type of bonds which are stable and rigid. There is a restriction in bond rotation. This restriction gives rigidity and rigidity gives rise to Cis trans isomerism which is also called diastereomerism in pi systems. So we are trying to work on the molecules which are C-C double bond and you have groups on 1 side of the double bond or the opposite side of the double bond.

When they are on the same side we call it as Cis and when the groups are on the opposite we call them as trans. The common examples are Cis-2-butene and trans-2-butene, these 2 compounds differ in their melting points Cis-2-butene melts at -138.9 degree centigrade. Whereas the trans-2-butene melts at -105.6 degree centigrade similarly the boiling point of Cis-2-butene is 3.7 degree centigrade. Whereas the boiling point of trans isomer is about 1 degree centigrade.

So this difference of physical property can be utilized to identifies these 2 isomers Cis and trans 2 butene, from our discussion on nomenclature we had got an idea of E and Z notation of double bonded compounds. So we would like to recall that here as well.

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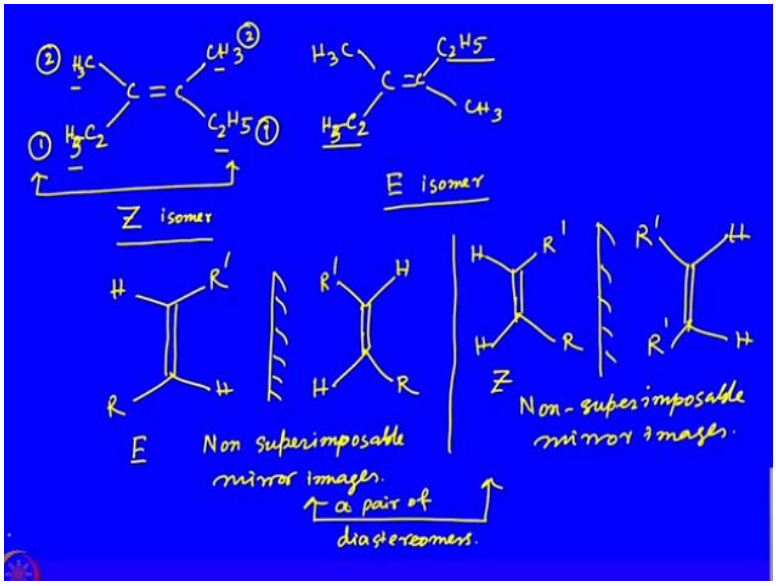

Suppose we have a compound which is this one and I have another compound which is this one. So what would be this stereochemistry or stereo-chemical designation of these 2 compounds. So what we learnt in our nomenclature lectures is that we then need to prioritize the groups which are connected to the double bond. And then based on those priority groups whether they are on the same side or different side we name them as E and Z.

So here in this case, the C2H5 group as higher priority over the methyl group here also C2H5 as higher priority over methyl group. So here the 2 high priority groups are on the same side so we call this as a Z isomer while here the high priority groups on the other opposite side of the double bond therefore we call this as E isomers. We will need these descriptors in this lecture in the following examples.

Suppose if I have these compounds, they are non-super imposable mirror images on the other hand the trans isomer sorry the Cis isomer if you should draw are also non-super imposable mirror images. And this isomer which is E and this is Z they represent a pair of diastereomers

we may encounter in our studies a number of compounds which may contain more than 1 double bond in that compound.

So when you have multiple double bonds maybe 2 or 3 double bonds we should then try to start identifying all possible stereoisomers of that compound. So when we have at least 2 double bonds let us see with 1 example.

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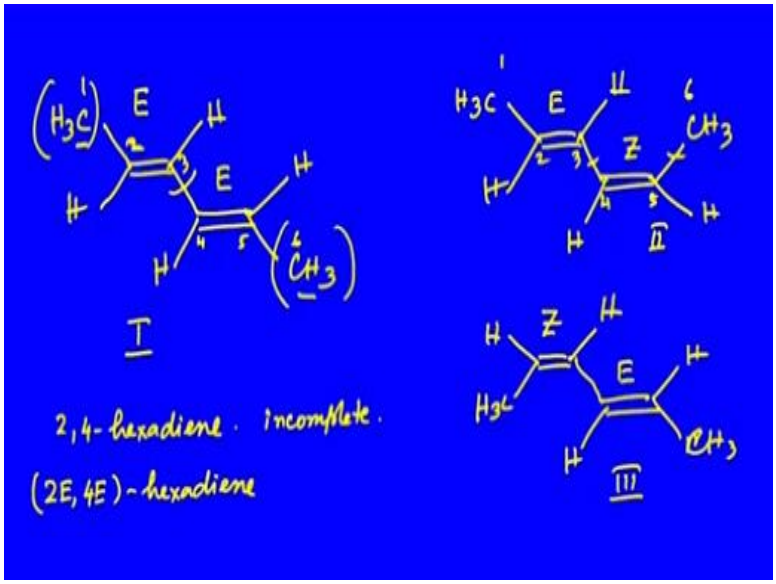

We have 1 isomer of 1, 2, 3, 4, 5, 6 so this is 2, 4 hexadiene but this name is incomplete why? Because we have not mentioned the stereochemistry of the double between 2 and 3 and 4 and 5 in terms of E and Z. So what should be the E, Z notation of this molecule the first one where the methyl group and the larger group are in opposition. So it should be E again here the methyl group number 6 and the larger group are in opposite side so that also should be E.

So the correct name of this compound should be 2E, 4E hexadine let us see what are the other possible isomers of this compound. So here this is E and this is Z because now here the 2 groups which are higher priority on the same side. So this should be numbered and then you can name them and the third possibility is this one. Where this bond is Z and this group is E so we have 1, 2 and 3 isomer that are possible for this compound. Now we will try to see what happens when we have 2 different groups at 2 ends of a diene.

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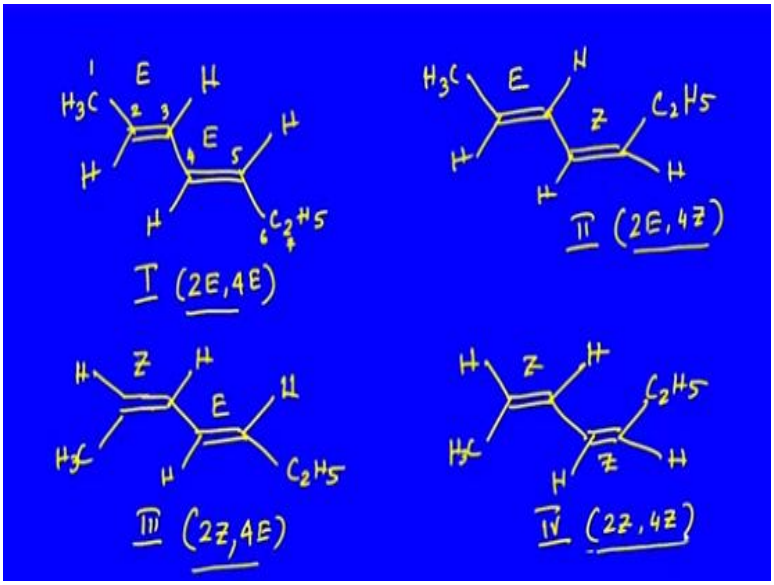

Suppose we have a methyl group here so this is 1 this is 2 this is third one and this is the fourth one. So if we try to identify these compounds with the E, Z notation if we see the molecule we always should number from left hand side so that the double bond gets the lowest priority. So this is heptadiene and in the first case this is 2E, 4E in the second case this is E but that is Z so it should 2E, 4Z. In the third case this is Z that is E so it should be 2Z, 4E and in the fourth case this should be Z and that also Z.

So it should be 2Z, 4Z so, here we have 4 isomers and they are diastereomers and they can be designated with appropriate E, Z nomenclatures as we have learnt in our previous class of IUPAC nomenclature. So I will give you one homework to find out what are the possible isomers of these compounds and identify them appropriately with their corresponding E, Z notations.

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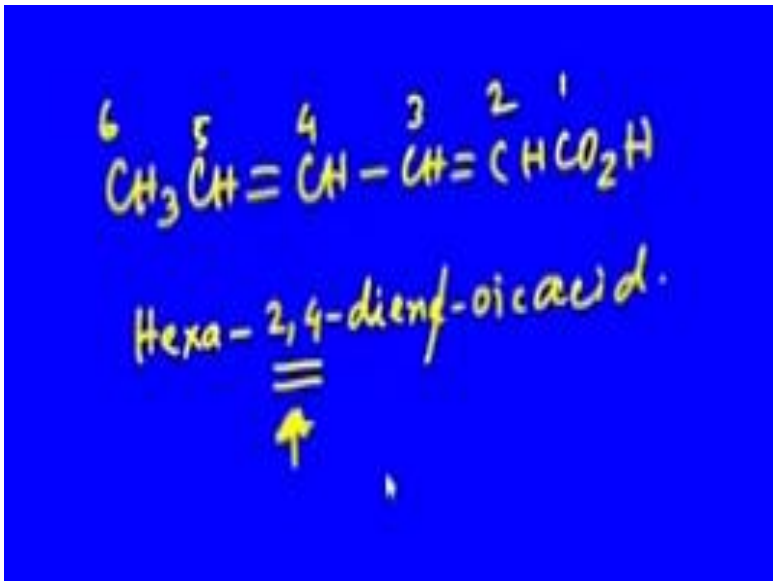

So the name of this compound should be 1, 2, 3, 4, 5, 6, so the name of the compound should be hexa 2, 4 diene oic acid. So here that -e- should be dropped so it should be diene and oic acid. But it you would have to identify the correct stereochemistry at 2 and 4 positions and draw all the isomers yourself.

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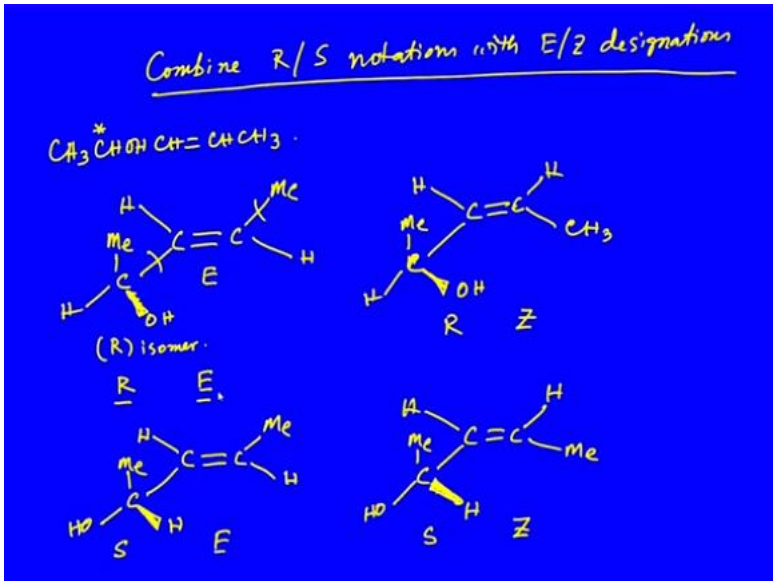

Let us see what happens when we try to combine the R/S notations with the E/Z designation. So when we are saying that there should be R/S notation that means the compound must contain a chiral center. So let us take one such example, so that is the chiral system so if you try to draw this molecule now we should draw it like this. So this is suppose the R isomer and this R isomer has 2 most prior groups in opposite side so this is E.

So the name should have the stereo-chemical designation R for the chiral center and E for the double bond. And the other hand this compound which is having the methyl group this side keeping the stereochemistry of the chiral center unchanged should have R and Z. I would like you to identify the names of these compounds and it is possible to have the S configuration of the chiral center.

So in that condition we should draw the molecule like this, this will be S and E whereas the other one should be S and Z. So this compound we should try to name them with the corresponding R and E descriptions, number the atoms appropriately and try to write down the name of these compounds yourselves.

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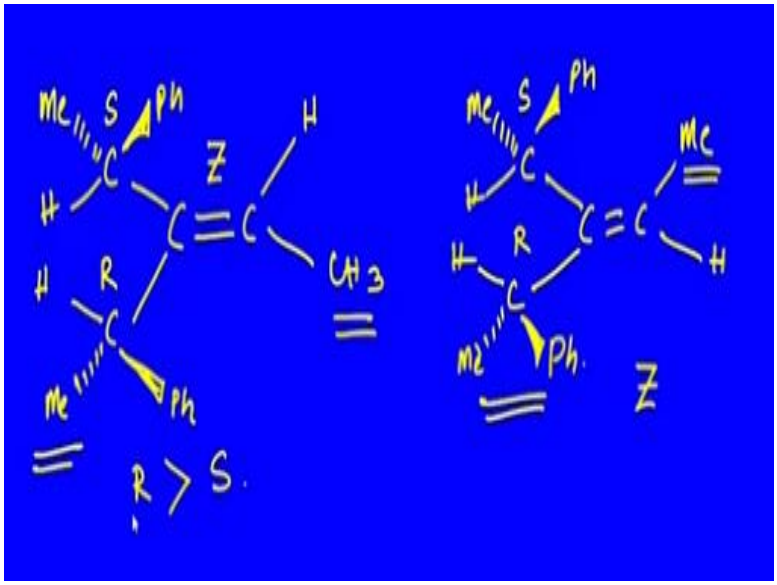

Now let us try to take one more example where we will have 2 chiral centers and both the chiral centers chiral carbons are present on the same carbon atom of the double bond. So this compound has this chiral center has S and this chiral center has the R designation. And when we try to name them the chiral center with R designation gets priority over S therefore the higher priority group is here and here so this compound has the double in the Z description.

Whereas in case of the other compound, this S and R the higher priority R and the methyl group are in opposite side of the double bond. So the double bond has the Z notation and the compound as appropriate R and S designation at the chiral centers. So this is how you can draw several

stereoisomers of the compounds which simultaneously contain a chiral center and also contains one or more double bonds.

So this you should practice from some standard textbook and draw the molecules and identify those chiral centers by R and S which we have already done in some of the previous lectures. So I do not want to continue discussing about how to identify R and S in this lecture. From here we will start our next lecture thank you.