Crystals, Symmetry and Tensors
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Lecture 18a
3D Point Groups I: Introduction

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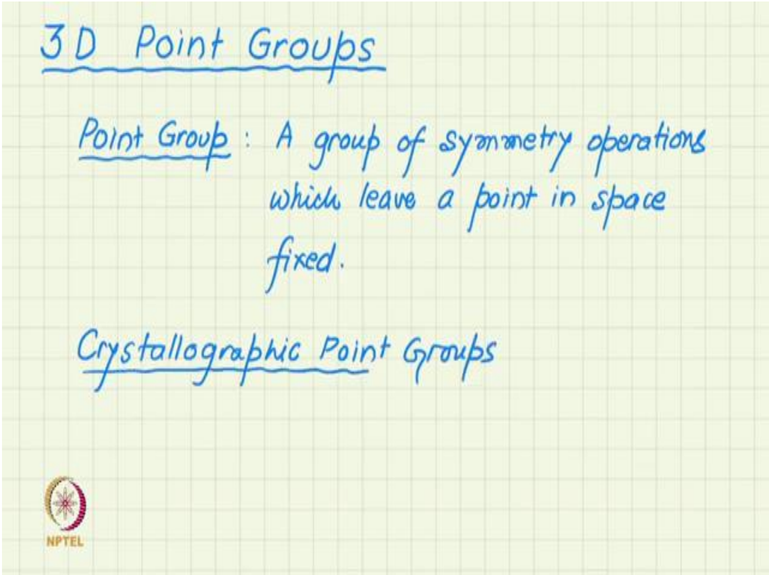

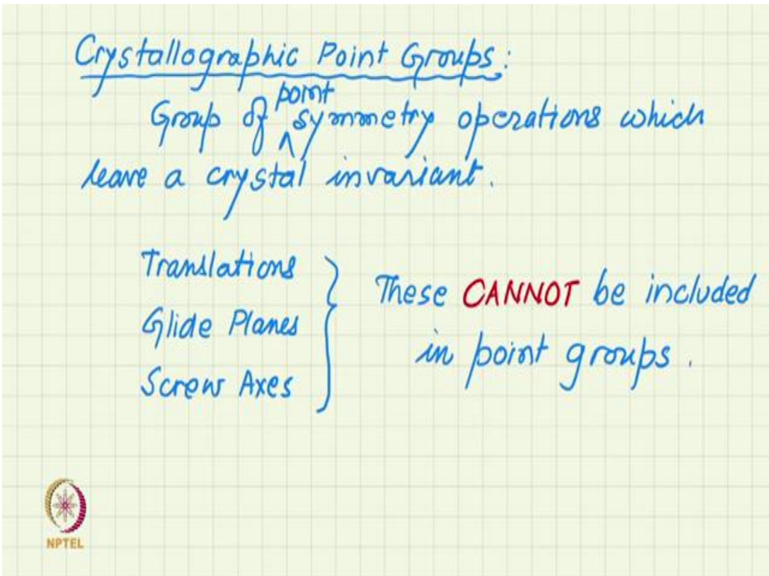

So, time has come now to discuss the three-dimensional Point Groups. Recall that by point group, by we mean a group of symmetry operations which leave a point in space fixed. Now, of course, we are interested in crystallographic point groups. So, in crystallographic point groups, we are interested in symmetry operation which leaves a crystal invariant. So, group of point symmetry operations which leave a crystal invariant.

Now, a point fixed in space are the ones which are point symmetry operations. So, as we have seen in our two-dimensional discussion also, this means that translations, glide planes, and screw axis we did not see in two-dimension, but I am noting here because they come in three dimensions only, all of these involve translations and translations move all the points. So, they can never leave any point fixed. So, these cannot be part of, these cannot be included point groups. So, we will take these up when we discuss the space group like we had done for two dimensions, but for point group these cannot be included.

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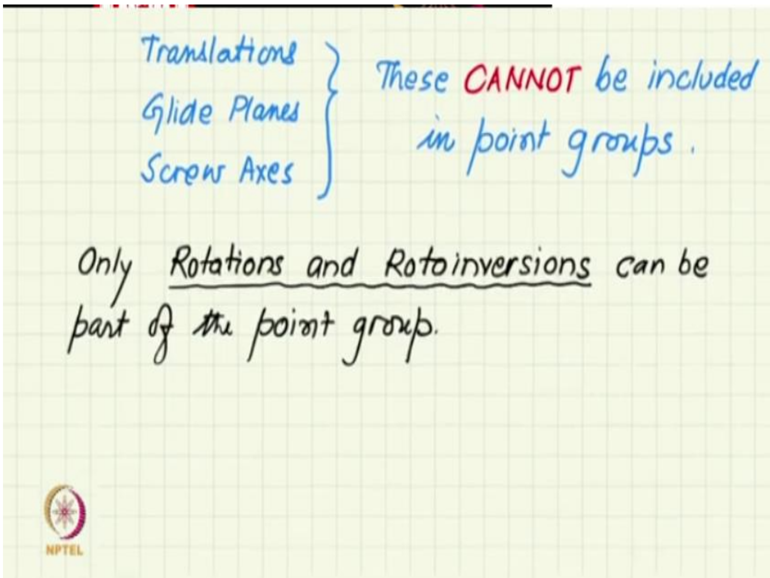

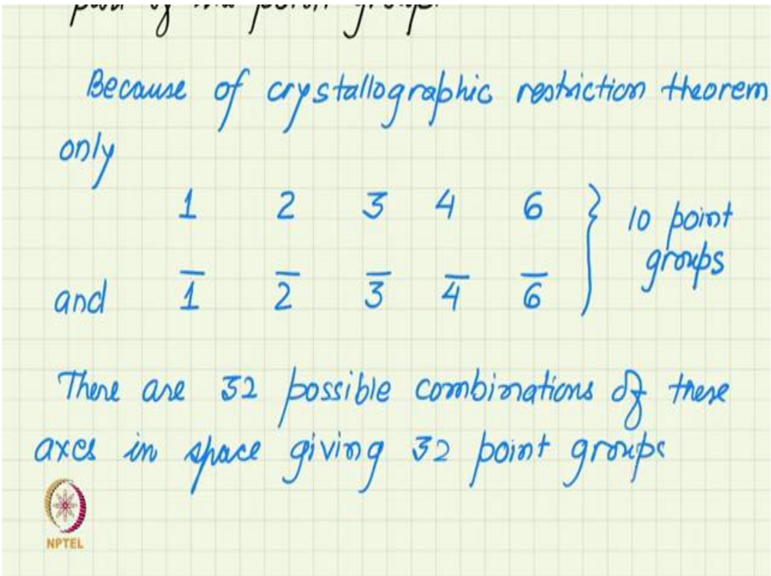

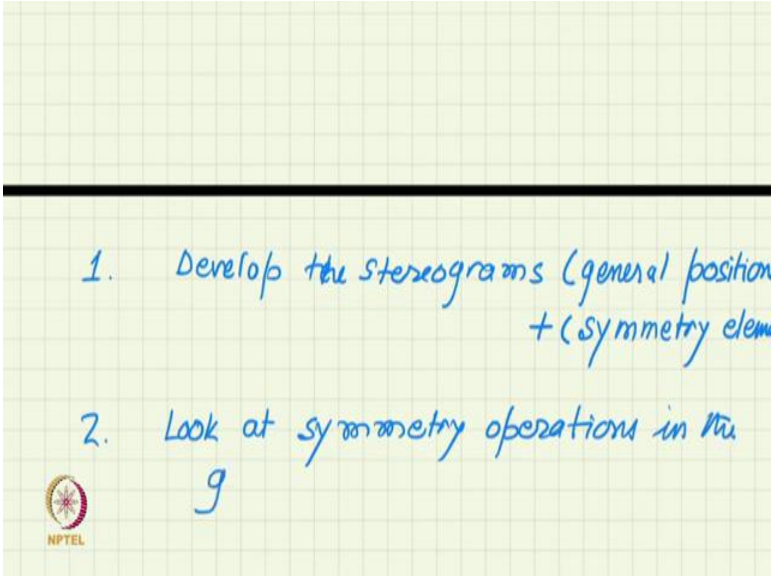

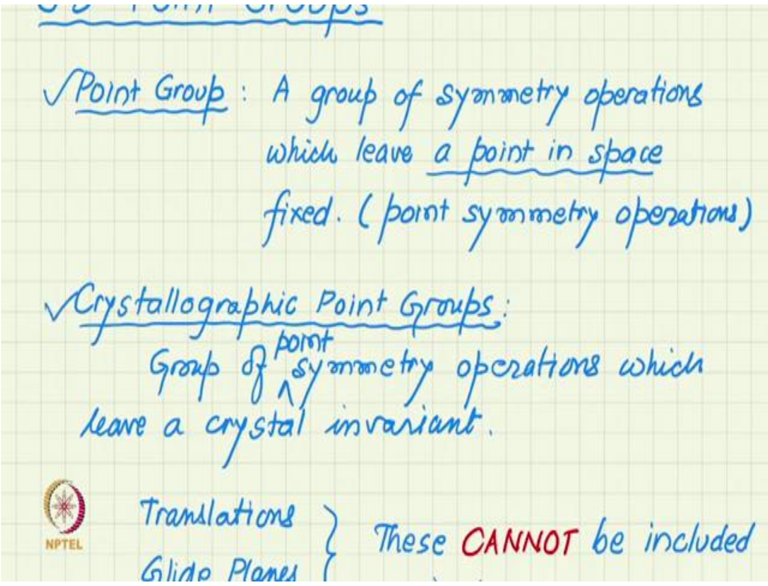

So, what can be included in the point groups are only rotations and Rotoinversions can be part of the point group, now the point group. So, we have also seen that because in this crystallographic point group normal point group can have rotations of any order any fold, but crystallographic point groups has the crystallographic restriction theorem.

Because, they have to leave the crystal invariant and that can happen only for certain rotation and Rotoinversions axis and these are because of the crystallography restriction theorem only five rotation axes, 1, 2, 3, 4 and 6 are allowed and only five Rotoinversion axes, 1 bar, 2 bar 3 bar, 4 bar and 6 bar are allowed. So, the point groups are combinations of these axes and these operations. So, these themselves constitute 5 plus 5, 10 point groups, but in total there are 32 possible combinations of these axes in space giving 32 point groups.

Now, we will not derive all these 32 point groups in a strict mathematical sense, but what is important for us is to become familiar with these 32 point groups, So, we will gradually develop them in a little intuitive way by looking at there. So, our job will be to look at their stereogram, develop the stereograms and look at stereograms will give the general positions. We will also include in the stereogram the symmetry elements and we will also look at the symmetry operations in the group. So, these two things we will do for the 32 crystallographic point group in gradual step in a somewhat systematic way in the coming videos. Thank you.