

CALIFORNIA STATE UNIVERSITY, LONG BEACH

# THE MATHEMATICS COLLOQUIUM

presents

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speaking on

*Topological Symmetry Groups*

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12:00PM-1:00PM

LA5-267

**Abstract:** The motivation for this subject originally came from the problem of how to analyze the symmetries of non-rigid molecules. This is a noteworthy problem for chemists since the symmetries of a molecule determine many of its chemical properties. Chemists have defined the *point group* of a molecule to be the group of rigid symmetries of its molecule graph in  $\mathbb{R}^3$ . While this group is a useful tool for analyzing rigid molecules, a molecule structure which is flexible or partially flexible may have symmetries which are not induced by a rigid motion of its graph in space. To study the symmetries of flexible graphs, we define the *topological symmetry group* of a graph embedded in  $\mathbb{R}^3$  to be the group of automorphisms of the abstract graph which are induced by homomorphisms of  $\mathbb{R}^3$ .

This group gives us a way to understand not only the symmetries of flexible molecule graphs, but the symmetries of any graph embedded in  $\mathbb{R}^3$ . It was proven by Frucht in 1938 that every finite group is the automorphism group of some connected graph. It is natural to ask whether every finite group is the topological symmetry group of some graph embedded in  $\mathbb{R}^3$ . We answer this question and give a survey of results about topological symmetry groups.