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## Abstract of Doctoral Dissertation

Degree requested Doctor of Science Applicant's name Tan Nhat Tran

Title of Doctoral Dissertation

*G*-TUTTE POLYNOMIALS VIA COMBINATORICS, TOPOLOGY AND MATROID THEORY  
(*G*-TUTTE多項式の組み合わせ論的、位相的、マトロイド理論的研究)

We introduce and study the notion of *G*-Tutte polynomial for a list of elements in a finitely generated abelian group and an abelian group *G* through combinatorial, topological and matroid theoretical aspects. The *G*-Tutte polynomial establishes a common generalization of several “Tutte-like” polynomials appearing in the literature such as the (arithmetic) Tutte polynomial of realizable (arithmetic) matroid, the characteristic quasi-polynomial of integral arrangement, the Brändén-Moci's arithmetic version of the partition function of an abelian group-valued Potts model, and the modified Tutte-Krushkal-Renhardy polynomial of a finite CW-complex.

Through combinatorial viewpoint, we generalize the characteristic polynomials of hyperplane and toric arrangements to that of abelian Lie group arrangements and in turn give two arrangement theoretic interpretations for every constituent of the chromatic quasi-polynomial. Passing from general to particular consideration, we give several results on the characteristic quasi-polynomials of arrangements arising from root systems in connection with Ehrhart theory, Eulerian polynomial and signed graph. From topological viewpoint, we prove that the semialgebraic and topological Euler characteristics and Poincaré polynomial of a certain abelian Lie group arrangement can be expressed in terms of the associated *G*-Tutte polynomial, which generalizes many classical formulas. From matroid theoretical viewpoint, we prove that the *G*-Tutte polynomial, like many of its specializations, possesses deletion-contraction and convolution formulas, but unlike them, the *G*-Tutte polynomial may have negative coefficients. We propose some ideas and partial answers for finding under what conditions the *G*-Tutte polynomial has positive coefficients.