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Abstract :

In this thesis, rank 3 groups are studied combinatorial and in a systematic way. The first chapter is introductory, and gives some basic definitions, terminology and preliminary concepts. In Chapter 2, we study the relationship between rank 3 groups and strongly regular graphs. We also give a necessary and sufficient condition for a group G to be primitive. Finally in section 3, ~provide basic facts and parameters used in theoretical and computational work on rank 3 groups. In Cliapter 3, we discuss five families of parameters of rank 3 graphs and their corresponding automorphism groups of rank 3. In the last section, we investigate an important class of rank 3 graphs with no triangles. In Section 1 of Chapter 4, we prove that the existence of a balanced incomplete block design implies the existence of a strongly regular graph with certain parameters. In section 2, we give a new proof for the existence of a rank 3 graph having parameters (18,9,9) and find its corresponding rank 3 group. In Section 3 , we prove the existence of a new rank .. 3 graph with parameters (25,8,4) and find its corresponding rank 3 group. In the fourth and final section of this Chapter, we discuss a new family of rank 3 graphs. We prove its feasibility for all integers m ~ 2. But rer\.1izability is established only for m = 2, as the classical simple group P Sp(4,3) of order 25,920 is the corresponding rank 3 group in this case. In Chapter 5, we give a classification of finite primitive permutation groups of rank 3 by determining the groups in which the socle L of G is a sporadic simple group. In Section 1, we make a complete table of all such 19 sporadic simple groups of rank 3. In Section 2, we study, in great detail, the historical Higman- Sims sporadic simple group of rank 3 of order 44,352,000 [21]. In the third and last section we discuss briefly the first nine sporadic I simple groups of rank 3

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