UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

CLASSIFICATION OF GROUPS OF ORDER 16

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IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL

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ABSTRACT

Abstract algebra, also known as modern algebra is a broad division of mathematics. It is the set of advanced topics of algebra that deal with abstract algebraic structures of various sets such as real numbers, complex number, vector spaces and matrices rather than rules and procedures for manipulating their individual elements. The important of these structures are group, ring and field. This research has been conducted to classify the group of order 16 as it is always obtained as a special case of sophisticated theory of p-groups. Group is defined as a set G which is closed under the binary operation while a group is called a p-group if it has the order of power of prime. To prove that there is no more group of order n is the problem that has been arisen during this research. To make the classification of groups easier and also as the solution to the problem, the idea of group presentation is used. Presentation of group is one of the methods of defining a group. The groups are formed by giving a set of generators and certain equations which are satisfied by the generators. The objectives for this project are identifying all the groups of order 16 and determining their abelian groups. At the end of this research on classification of groups of order 16, 14 groups has been obtained which the first five is abelian and the rest of it is non-abelian.

1 INTRODUCTION

According to Benjamin Baumslag And Bruce Chandler (1968), symmetry is one of the vital intuitive ideas in mathematics and science. Every symmetrical object is associated with a group theory as stated by Manalo E.M (2001). Group theory is a mathematical technique for dealing with problems of symmetric like the molecules symmetry as it reveals information about its properties like the structure, spectra, polarity and chirality. Eventhough the notions of symmetry had been used extensively since century ago, but the use of formal group theory is a very recent development. It is shown that symmetry was a useful concept in the design of ornaments with symmetries, the observation of periodic patterns and the regular appearances of the sun and other astronomical objects.

Furthermore, Manalo E.M (2001) prove that every group theory has its own importance which are relevant to every branch of Mathematics. Nonetheless, the applications of group theory are also abounded and endless. For instance, group theory plays crucial role in formulation of physics where there is relation between groups with symmetries. Moreover, group theory is used to describe symmetries crystal and molecular structures in chemistry as stated by Morton Hamermesh (1989).

The theory of abelian groups is a branch of abstract algebra, which deals with commutative groups, named after the Norwegian mathematician Niels H. Abel. His method bear only a slight resemblance to the non-commutative case as it is rather independent of general group theory. However, there is a close relationship between abelian group and the theory of modules, especially over integral domains as mentioned by "Springer Monographs in Mathematics" (2015). The theory of finite abelian group is said to be initiated by Carl Friedrich Gauss in 1801 as explained by Israel Kleiner (1986). An abelian group was formed from integers with standard addition. The real numbers form an abelian group under standard multiplication. For instance, balancing check book is one of the applications of abelian group.