5th Biennial International Group Theory Conference

Conference Report

by

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A Report from The 5th Biennial International Group Theory Conference
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Day 1

Welcome and Opening Addresses

Welcoming speakers, Dr. Intan Muchtadi as chair of The 5th Biennial International Group Theory Conference (5BIGTC), gave welcoming speech to all audiences, including to scientific committee, keynote speakers, invited speakers, contributed speakers, and also participants who came from at least five different nations. She was very honor to have an opportunity to hold the conference. She wished all participants could enjoy the conference and also could enjoy Bandung's environment especially. She also introduced the sponsors of the conferences which are Indonesian Ministry of Research, Technology and Higher Education, International Mathematical Union, Faculty of Mathematics and Natural Sciences ITB, P3MI, and Algebra Research Group ITB. The BIGTC that being held in Bandung Indonesia is the fifth one, the first until the fourth was held in Malaysia, Turkey, Iran and Malaysia, respectively.

In the second **welcoming speech**, Prof. Ahmad Erfanian as chair of scientific committee appreciated to all participants who had come from their countries to Indonesia. He was very thankful to all participants who could inspire and gave insight to other participants in this conference. He emphasized that all abstracts are great.

After that, **officiating speech** was given by Prof. Dr. Irawati, the Vice Rector of Insitut Teknologi Bandung. In her speech, Prof Irawati emphasize that mathematicians especially here, algebraists and group theorists, must continue pushing the boundary of mathematics forward, in every direction possible, opening up every possible venue of applications which eventually lead to contributions to the advancement and the betterment of society.

The first plenary speaker was chaired by Prof. Manabu Oura. In the **first plenary session,** Prof. Mahmut Kuzucuoglu from Middle East Technical University, Turkey presented about *Limit Monomial Groups.* He reviewed that there are three principal types of representations of groups. These are (1) Permutation representation (2) Linear representation (3) Monomial representation. The permutation representation and linear representation of groups are studied extensively and the main properties of these representations are well known. The finite degree monomial representations of groups are studied by O. Ore in *Theory of monomial groups, Trans. Amer. Math. Soc. 51, 15–64, (1942)*. The infinite degree monomial representations are studied by R. B. Crouch in *Monomial Groups, Trans. Amer. Math. Soc. 80, 187–215, (1955)*. The basic properties of direct limit of monomial groups of finite degree is studied in *Homogeneous monomial groups and centralizers, Comm. in Algebra 46, 597–609, (2018)*. The structure of centralizers of elements in limit monomial groups, the classification of such groups using Steinitz numbers and isomorphisms of limit monomial groups are studied in *Homogeneous monomial groups and centralizers, Comm. in Algebra 46, 597–609, (2018)*. He mentioned the following theorem. **Theorem**. Let λ and μ be two Steinitz numbers. The homogeneous monomial groups $\Sigma_\lambda(H)$ and $\Sigma_\mu(G)$ are isomorphic if and only if $\lambda = \mu$ and $H \cong G$ provided that the splittings of $\Sigma_\lambda(H)$ and $\Sigma_\mu(G)$ are regular. He proposed to discuss, construction of direct limit of infinite degree monomial groups over arbitrary group H. Then the basic properties of constructed limit group, the structure of centralizers of elements and conjugacy of two elements in limit monomial groups will be studied.

The first invited speaker was chaired by Prof. Man Van Minh Nguyen. In the **first invited session**, Prof. Murray Elder from University of Technology Sydney, Australia spoke about *Equations in Groups*. An *equation* in a group or monoid is simply a pair of words over *variables* $X, Y, Z, \dots$ and elements of the group/monoid. For example, an equation in the free monoid $\{a, b\}^*$ might be

$$aaX = Ybb$$

A *solution* to an equation is a mapping $X \mapsto u, Y \mapsto v$ so that replacing variables by group/monoid elements in the equation makes the left and right sides equal. In our example, $X \mapsto bb, Y \mapsto aa$ is one possible solution (in the free monoid, the two sides are equal if and only if they are identical as words, but in other monoids and groups this is not necessarily true). Makanin gave a complicated algorithm to decide whether or not an arbitrary equation in a free monoid had a solution in 1977. In 1983 he extended the result to equations in free groups. Rips and Sela extended this further to hyperbolic groups without torsion, and in 2010 Dahmani and Guirardel to all hyperbolic groups. He described the work of many authors, coming from Computer Science, to not only decide but find all possible solutions to an equation in a free monoid/group in extremely low space complexity. Moreover the new algorithms give a relatively simple description (as a formal language) of the solution set. His results were joint with Laura Ciobanu (Heriot-Watt) and Volker Diekert (Stuttgart).

In the **second invited session,** chaired by Prof. Alireza Abdollahi, Prof. Ali Iranmanesh from Tarbiat Modares University, Iran talked about *Influence of Character Degrees on the Structure of Nearly Simple Groups*. A fundamental question in representation theory of finite groups is the extent to which complex group algebra or character degree set of a finite group determines the group or some of its properties. It is known that, in general, the complex group algebra or the character degree set of a finite solvable group does not determine the group structure up to isomorphism. In contrast to solvable groups, the non-abelian (nearly) simple groups seems to have a stronger relation to their complex group algebras or their set of character degrees. Indeed, it has been recently shown that finite quasi-simple groups are determined uniquely (up to isomorphism) by the structure of their complex group algebras. Furthermore, a celebrated conjecture of Huppert in *Some simple groups which are determined by the set of their character degrees. I. Illinois J. Math., 44 (2000) 828--842* states that finite non-abelian simple groups are uniquely determined up to an abelian direct factor by the set of their character degrees. He surveyed on recent improvements of the above results including his recent project aimed at extending the above results to almost simple groups. In particular, he discussed the following results. **Theorem:** Let $n \geq 2$ and $PSL_n^{\epsilon}(q) \leq G \leq PGL_n^{\epsilon}(q)$ be an almost simple group where $q-\epsilon$ is not a divisor of n or $n-1$. Then G is determined up to isomorphism by the structure of its complex group algebra (here, $\epsilon = +$ if G is of linear type, and $\epsilon = -$ if G is of unitary type). He also proposed an extension of Huppert's conjecture from non-abelian simple groups to almost simple groups of Lie type. **Conjecture B**: Let G be a finite group and H be an almost simple group of Lie type with $cd(G) = cd(H)$. Then $\frac{G}{A} \cong H$ for some abelian normal subgroup A of G. In view of Huppert's conjecture, he showed that G is not necessarily the direct product of H and A, and also the converse implication does not necessarily hold for almost simple groups. Furthermore, He explained his recent work on verifying **Conjecture B:** for some almost simple groups of Lie type of low ranks and also on verifying the Huppert original conjecture for the family of projective special linear groups $PSL_5(q)$.

After second invited, **first parallel session** was held in the conference. It was divided into 2 rooms. We call it room A and room B from now on. Room A with Prof. Mahmut Kuzucuoglu as chairman and room B with Dr. Fajar Yuliawan as chairman.

At room A in the **first contributed session**, Thekiso Seretlo from University of Limpopo, South Africa talked about *On a Group of the Form* $2^{4+5}{:}GL(4,2)$. The affine general linear group $2^5{:}GL(5,2)$ of $GL(6,2)$ has 6 conjugacy classes of maximal subgroups. The largest two maximal subgroups are of the forms $2_+^{1+8}{:}GL(4,2)$ and $2^{4+5}{:}GL(4,2)$. In this article we consider the group $2^{4+5}{:}GL(4,2)$, which he denoted by $\overline{G}$. Firstly he determined its conjugacy classes using the coset analysis technique. The structures of the inertia factor groups are also determined. He then computed all the Fischer matrices and apply the Clifford-Fischer theory to compute the ordinary character table of $\overline{G}$. Using information on conjugacy classes, Fischer matrices and both ordinary and projective character tables of the inertia factor groups, he concluded that he need to use the ordinary character tables of all the inertia factor groups to construct the character table of $\overline{G}$. The character table of $\overline{G}$ is a 75×75 complex valued matrix and he showed part of it (in the format of Clifford-Fischer theory) at the end of this paper.

Meanwhile at room B, Lucky Cahya Wanditra, from Institut Teknologi Bandung, spoke about *Wave Packet Transform on Finite Abelian Group*. By using the wave packet transformation on cyclic group, he explained the wave packet transformation on finite abelian group. In the case of cyclic group, this is a transformation on Banach space formed by using cyclic group representation. He generalized this result to transformation formed by group representation of an abelian group.

After that at room B, in the **second contributed session**, Masoumeh Ganjali from Ferdowsi University of Mashhad gave speech about *Some Notes on Non-Inner Nilpotent Groups*. The purpose of this talk is to state some new results on an α-nilpotent group, which was introduced by Barzegar and the second author, for any fixed automorphism α of group G. They investigated some properties of an α-nilpotent group and proved that an α-nilpotent group is nilpotent but the converse is not valid in general. Therefore, she tried to prepare some conditions that under them a nilpotent group is nilpotent related to some automorphism. A group G is said to be non-inner nilpotent, whenever it is nilpotent related to a non-inner automorphism of group G. She provided some examples of non-inner nilpotent groups, also proved that every nilpotent group of maximal class is non-inner nilpotent and she tried to classify all finite non-abelian non-inner nilpotent groups of orderp^n, $n \leq 5$, for an odd prime p. Central automorphisms fixing the center of a group element-wise may play an important role to this classification.

Meanwhile at room A, Malebogo Motalane, from University of Limpopo, South Africa, presented about *The Conjugacy Classes Ranks of* M_{23}. Let G be a finite group and X be a conjugacy class of G. The rank of X in G, denoted by $rank(G : X)$, is defined to be the minimum number of elements of X generating G. He investigated the ranks of the sporadic simple group M_{23}. He used the structure constants method to determine the ranks of all the non-trivial classes of M_{23}.

After this parallel session, we are back to main hall to have **third invited** speech by Kai Meng Tan from National University Singapore. He spoke about *Jantzen Filtration, Young Symmetrizers, and Young's Seminormal Basis*. For each partition λ of a positive integer n, let S^λ denote its associated Specht module of the symmetric group S_n. This is a cyclic module generated by its Young symmetrizer Y^λ, and has a distinguished basis called Young's seminormal basis. It also has a well-known p-Jantzen filtration. Let μ be another partition, say of m. He showed that the i-th term of the p-Jantzen filtration of $S^{\lambda+\mu}$ projects onto that of $S\^\lambda$ for all $i \in \mathbb{Z}^+$ if the canonical projection $\left(S^\lambda \boxtimes S^\mu\right) \uparrow_{S_n \times S_m}^{S_{n+m}} \twoheadrightarrow S^{\lambda+\mu}$ splits over $\mathbb{Z}_p$, the localised ring of $\mathbb{Z}$ at the prime ideal (p). Furthermore, this splitting condition can be explicitly stated in terms of the greatest common divisor of a certain product of Young symmetrizers, as well as in terms of the denominator of a certain Young's seminormal basis vector.

Moreover, we have **fourth invited session**, Man Van Minh Nguyen from Mahidol University, Thailand, talked about *Quality Engineering with*

Orthogonal Arrays: Algebraic Methods with and Without Group Theory. He primarily talked about a single problem: the construction of a special class of fractional factorial experimental design F (named mixed orthogonal arrays), motivated by Statistical Quality Control (SQC) applications. The problem's solutions specifically focus on algebraic approaches, with two folds of using and not using *group-theoretic computation*. These algebraic methods and algorithms are based on elegant ideas from active fields of mathematics (as *algebraic geometry*) and statistics (as *optimal balanced designs* and more practically *industrial statistics*). Quality is a broad concept, often it refers to a *grade of excellence*, literally means consistently meeting standards appropriate for a specific product or service. Quality Engineering and SQC particularly concern about *mathematically designing* goods for daily uses or accurate devices for engineering from which he could measure responses, collect numerical data, then analyze and control *quality characteristics* of those products before actually manufacture them on assembly lines in factories. Large firms have applied major principles of SQC in mass manufacturing of products for years, in various sectors of any economy, from dairy industry, telecommunication to automobile sector. The first phase uses designed experiments - (DOE or *Experimental Designs*, and specifically *Factorial Experimental Design*-FED) - a sequence of experiments performed under controlled conditions which produces measurable outcomes; and in the second phase we could employ various popular *Shewhart control charts*, Six-Sigma and DMAIC methodology. Mathematically, the main aim of using FED (and other structures of DOE) is to identify an unknown function g, determined on a full design D, a mathematical model of a quantity of interest (favor, usefulness, best-buy, quality ...) which has to be computed or optimized.

Day 2

The second day began with the wake-up **second plenary** session. This plenary session was presented by Prof. Mark Lewis from Kent State University, USA with title *Groups Where the Centers of the Irreducible Characters Form a Chain* and chaired by Prof. Mahmut Kuzucuoglu. Throughout his talk, all groups are finite. He considered groups where the centers of the irreducible characters form a chain. He obtained two alternate characterizations of these groups. One of these characterizations involves the centers of all quotients of the group. The other characterization looks at finding a chain of normal subgroups that have a given problem. He obtained some information regarding the structure of these groups. In particular, he obtained a necessary and sufficient condition for a nested group to be nilpotent. Using his results, he is able to classify those groups where the kernels of the irreducible characters form a chain. He also classified the groups where the kernels of the nonlinear irreducible characters form a chain. This generalizes a result of Qian and Wang that answered a question that was posed by Berkovich. A GVZ-group is a group where every irreducible character vanishes off its center. He considered some alternate definitions of nested groups, and he showed for GVZ-groups, that these different definitions are equivalent. He presented examples that show that these different definitions are not equivalent for all groups. He showed that a result of Nenciu regarding nested GVZ groups is really a result about nested groups. He gave strong results regarding nested groups that are nilpotent of nilpotence class 2. Finally, he obtained an alternate proof of a theorem of Isaacs regarding the existence of p-groups with a given set of irreducible character degrees.

In the **fifth invited session**, chaired by Prof. Mahmut Kuzucuoglu from University of Isfahan, Iran, Prof. Alireza Abdollahi, spoke about *Zero divisors of support size 3 in group algebras and trinomials divided by irreducible polynomials over* $GF(2)$. A famous conjecture about group algebras of torsion-free groups states that there is no zero divisor in such group algebras. A recent approach to settle the conjecture is to show the non-existence of zero divisors with respect to the length of possible ones, where by the length we mean the size of the support of an element of the group algebra. The case length 2 cannot be happen. The first unsettled case is the existence of zero divisors of length 3. He stated possible length 3 zero divisors in the rational group algebras and in the group algebras over the field $\mathbb{F}_p$ with p elements for some prime p. As a consequence, he proved that the rational group algebras of torsion-free groups which are residually finite p-group for some prime $p \neq 3$ have no zero divisor of length 3. He noted that the determination of all zero divisors of length 3 in group algebras over $\mathbb{F}_2$ of cyclic groups is equivalent to find all trinomials (polynomials with 3 non-zero terms) divided by irreducible polynomials over $\mathbb{F}_2$. The latter is a subject studied in coding theory and we add here some results, e.g. he showed that $1 + x + x^2$ is a zero divisor in the group algebra over $\mathbb{F}_2$ for some element x of the group if and only if x is of finite order divided by 3 and he found all β in the group algebra of the shortest length such that $(1 + x + x^2)\beta = 0$; and $1 + x^2 + x^3$ or $1 + x + x^3$ is a zero divisor in the group algebra over $\mathbb{F}_2$ for some element x of the group if and only if x is of finite order divided by 7.

In the **sixth invited session**, chaired by Prof. Pudji Astuti, Prof. Nor Haniza Sarmin from Universiti Teknologi Malaysia talked about *The Laplacian energy of conjugacy class graph of Dihedral groups*. The energy of a graph is defined as the sum of the absolute values of its eigenvalues. These eigenvalues are obtained from the incidence matrix of the graph. The Laplacian energy of a graph is defined as the sum of the absolute deviations (i.e. distance from the mean) of the eigenvalues of its Laplacian matrix. Let G be the dihedral group and Γ_G^{cl} $ its conjugacy class graph. In this research, the generalized formula for the Laplacian energy of the conjugacy class graph of dihedral groups are obtained. She presented, the Laplacian matrices of the conjugacy class graph of dihedral groups with the eigenvalues are first computed. Then, the Laplacian energy of the graph is determined.

Next we had **second parallel session**. This session was chaired by Prof. Alireza Abdollahi at room A and Prof. Man Van Minh Nguyen at room B.

The first contributed talk at room A is from Mahboube Nasiri, from Ferdowsi University of Mashhad, Iran. She presented *A kind of graph associated to a fixed element and a subgroup of group*. Let G be a finite group, H be a subgroup of G and g be a fixed element of G. He introduced the relative g-noncommuting graph associated to g and H. The vertex set is G and two distinct vertices x and y are adjacent if $[x,y]$ is not equal to g and g^{-1}, whenever x or y belong to H. Recall that $[x,y]$ is the commutator of two elements x and y of G and is equal to $x^{-1}y^{-1}xy$. In this talk, He surveyed some graph theoretical properties like connectivity and diameter. Also, we investigate that graph with some conditions is K_n-free or a planar graph.

Meanwhile, at room B, Brilly Maxel Salindeho, from Universitas Mulawarman gave talk about *On groups whose associated graphs are friendship graphs*. Let G be a finite group. There are a number of ways to associate a simple graph to G. Let $\Gamma(G)$ be such graph. In this paper, he considered various definitions for $\Gamma(G)$ provided by some previously known studies. The aim is to study the existence of G such that $\Gamma(G)$ is a friendship graph and derive some conditions for such G to exist for each definition.

The second talk at room B was given by Amira Fadina Ahmad Fadzil from Universiti Teknologi Malaysia. She spoke about *Energy of Cayley graphs for alternating groups*. Let G be a finite group and S be a subset of G where S does not include the identity of G and is inverse closed. A Cayley graph of a finite group G with respect to the subset S is a graph where the vertices are the elements of G and two vertices a and b in G are adjacent if $ab - 1$ are in the set S. For a simple graph, the energy of a graph can be determined by its eigenvalues. Let Γ be a simple graph, then by the summation of the absolute values of the eigenvalues of the adjacency matrix of the graph, its energy can be determined. She presented the Cayley graphs of alternating groups of order below 60 with respect to the subset S of valency up to 3. From the Cayley graphs, their isomorphisms are presented, followed by their adjacency matrices and eigenvalues in order to compute their energy.

Meanwhile, at room A Nurhidayah Zaid from Universiti Teknologi Malaysia spoke about *Probabilistic characterizations of some ring of matrices and its zero divisor graph*. Let R be a finite ring. Commutativity degree of a group is the probability that two randomly selected elements from a group commute. This concept has been generalized in various groups, but not in rings. In this study, the probability that two random elements chosen from a ring have product zero is determined for some ring of matrices over $\mathbb{Z}_n$. Then, the results are used to construct the zero divisor graph which is defined as a graph whose vertices are the zero divisors of R and two distinct vertices x and y are adjacent if and only if $xy = 0$. Finally, some properties of the zero divisor graph are analyzed.

After that, Fariz Maulana from Universitas Mataram, Indonesia talked about *Prime ideal and almost ideal prime on Gaussian integer ring*. Prime numbers on Integer is an interesting topic on cryptography theory and code theory. In this talk, he presented the abstraction of prime number in ring theory that called prime ideal and almost prime ideal. This talk gave some properties of prime ideals and almost prime ideals on Gaussian integer ring by generalized its properties in integer. He found that prime ideal in Gaussian Integer is pZ[i] where p is Gaussian prime. He also found that almost prime ideals in Gaussian integer equivalent to prime ideals.

Meanwhile, at room B, Nur Idayu Alimon from Universiti Teknologi Malaysia spoke about *The Harary index of the non-commuting graph for Dihedral groups*. Assume G is a non-abelian group which consists a set of vertices, $V = \{v_1, v_2, \ldots, v_n\}$ and a set of edges, $E = \{e_1, e_2, \ldots, e_m\}$ where n and m are the positive integers. The non-commuting graph of G, denoted by Γ_G, is the graph of vertex set $G - Z(G)$, whose vertices are non-central elements, in which $Z(G)$ is the center of G and two distinct vertices are connected if and only if they do not commute. In addition, the Harary index of a graph Γ_G is the half-sum of the elements in the reciprocal distance of D_{ij} where D_{ij} the distance between vertex i and vertex j. In this talk, the Harary index of the non-commuting graph for dihedral groups is determined and generalised.

In the afternoon, we had the **third parallel session**. Room A was chaired by Prof. Murray Elder and room B was chaired by Prof. M.R. Darafsheh.

The first speaker at room A was Nabilah Najmudin from Universiti Teknologi Malaysia. She spoke about *The independence, clique and clique-independence polynomials of the center graph of some finite groups*. The independence, clique and clique-independence polynomials are the graph polynomials that are used to describe the combinatorial information of graphs, including the graphs related to group theory. An independence polynomial of a graph is the polynomial in which its coefficients are the number of independent sets in the graph. The independent set of a graph is a set of vertices that are not adjacent. A clique polynomial of a graph is the polynomial containing coefficients that represent the number of cliques in the graph. The clique of a graph is a set of vertices that are adjacent to each other. A clique-independence polynomial is a newly defined graph polynomial in which it contains coefficients that represent the number of clique-independent sets in the graph. The clique-independent set of a graph is a collection of pairwise vertex-disjoint cliques. Meanwhile, the center graph of a group G is a graph in which the vertices are all the elements of G and two distinct vertices a,b are adjacent if an only if ab is in the center of G In this research, the independence, clique and clique-independence polynomials are established for the center graph of three finite nonabelian groups which are dihedral groups, generalized quarternion groups and quasidihedral groups.

Meanwhile at room B, there was a talk from Abdul Gazir. He is from Universitas Mataram, Indonesia. His talk was titled *Some properties of coprime graph of Dihedral group* D_{2n}. Research on algebra structures represented in graph theory led the way to a new topic of research in recent years. In his talk, the algebraic structure that was represented in the coprime graph is the dihedral group and its subgroup. The coprime graph of group G denoted by Γ_G is a graph with vertices consisting of all elements of G. Two different nodes x and y of G are adjacency if $(|x|,|y|) = 1$. Some properties of coprime graphs from a dihedral group D_{2n} are obtained. One of the results is when n is prime then $\Gamma_{D_{2n}}$ form a bipartite graph and when n is composite then $\Gamma_{D_{2n}}$ form a multipartite graph.

Next at room B, Masriani from Universitas Mataram spoke about *Non coprime graph of integers modulo* n *group*. One interesting topic in algebra and graph theory is graph representation of a group, especially the representation of a group using a non coprime graph. The non coprime graph of group G denoted by $\overline{\Gamma}_G$, is a graph with vertices consisting of all elements of G/{0}. Two different vertices x and y in $\overline{\Gamma}_G$, are adjacent if $(|x|,|y|) \neq 1$. In this talk, she described some properties of non coprime graph of integers modulo n Group.

Meanwhile at room A, Rizki Fadli, from Physics Department, Institut Teknologi Bandung, from *Finite energy static SU(2) skyrmionic black holes with negative cosmological constant in even dimension*. In the talk he considered a class of black holes in Einstein-Skyrme theory in even dimensional theories with negative cosmological constant Λ turned on which generalizes the results in [1, 2]. In addition, the Skyrme scalar field is chiral admitting a complex unitary group SU(2). He took some assumptions as follows [3]. First, we simplify the spacetime to be conformal to a product space $\mathbb{M}^4 \times \mathbb{N}^{N-4}$ where $\mathbb{M}^4$ and $\mathbb{N}^{N-4}$ are a four dimensional spacetime and a compact Einstein $(N - 4)\$$ -dimensional submanifold with $N \geq 4$, respectively. Second, the representation of the group SU(2) is taken to be fundamental which means that we can use the 2×2 Pauli matrices in the theory. Third, the Skyrme field is static which depends only on the radial coordinate r. Then, we derive the Einstein field equation and the scalar equation of motions related to these setups. His analysis showed that near boundaries, namely near horizon and around the asymptotic region, the geometries are of constant scalar curvature. To be precise, the near horizon geometry is a product space, whereas the geometry in the asymptotic limit is Einstein with negative cosmological constant. Finally, He performed Lipshitz localization method to show the local existence of solutions, and then, using the energy functional he showed that finite energy solutions could exist.

Then at room A, Athirah Zulkarnain from Universiti Teknologi Malaysia presented *Cayley graph for the non-abelian tensor square of some finite groups*. The Cayley graph, denoted as $\Gamma(G,S)$, is a graph which can be constructed for a group G and subset S of G. Let G be a group and S be a subset of G which is inverse closed and has no identity element. Two vertices of $\Gamma(G,S)$, labelled as x and y, are connected if $sx = y$ for some $s \in S$. Meanwhile, the non-abelian tensor square of a group G, $G \otimes G$, is a group generated by the symbols $g \otimes g$ for all $g, h \in G$, subject to relations $gh \otimes k = (\{g^h\} \otimes \{k\text{^}h\})(h \otimes k)$ and $g \otimes hk = (g \otimes k)(\{g^h\} \otimes \{k\text{^}h\})$ for all $g, h, k \in G$, where $\{g^h\} = \{h^{-1}\}gh$. In this talk, the Cayley graphs of the non-abelian tensor square are constructed for some groups of small order. Seven subsets are obtained from the non-abelian tensor square of S_3, $S_3 \otimes S_3$. Hence, there are seven different Cayley graphs for $S_3 \otimes S_3$. There are 15 subsets with valency one for the non-abelian tensor square of D_8,$D_8 \otimes D_8$. The Cayley graphs for these 15 subsets with valency one of $D_8 \otimes D_8$ are complete graphs.

Meanwhile at room B, there was talk from Rina Juliana. She is from Universitas Mataram, Indonesia. This talk was titled by *Coprime graph of integers modulo n group and its subgroups*. Coprime Graph is a geometric representation of a group in the form of undirected graph. The coprime graph of a group G, denoted by Γ_G is a graph whose vertices are all elements of group G, and two distinct vertices a and b are adjacent if and only if $(|a|, |b|) = 1$. In this talk, she observed coprime graph of integers modulo n group with its subgroups. One of the results is if n is a prime number, then coprime graph of integers modulo n group is bipartite.

Afterward, we were back to main hall again to hear invited speak from two professors. First professor (as **seventh invited speaker**) is Prof. Muhammad Reza Darafsheh from University of Tehran, Iran. This talk was chaired by Prof. Murray Elder. He spoke about *On rational irreducible characters of finite groups*. Let χ be a complex irreducible character of a group G. The field generated by all $\chi(x)$, $x \in G$, is denoted by $\mathbb{Q}(\chi)$. The character χ is called rational if $\mathbb{Q}(\chi) = \mathbb{Q}$. A group G is called a rational group or a $\mathbb{Q}$-group if all irreducible complex characters of G are rational. The order and structer of $\mathbb{Q}$-groups are restricted, for example by a result of Feit and Seitz the simple $\mathbb{Q}$-groups are among the Wyle groups of the simple Lie algebras and their extensions, while by a result of Gow the order of a solvable $\mathbb{Q}$-group is divisible by numbers 2, 3 or 5. Despite these fact the complete structure of a $\mathbb{Q}$-group of order a power of 2 is not completely known. He surveyed recent results on classifying $\mathbb{Q}$-groups.

Second professor (as **eighth invited speaker**) is Prof. Manabu Oura from Kanazawa University, Japan. This talk was titled with *Ring of the weight enumerators of triply even codes* and chaired by Prof. Nor Haniza Sarmin. A binary code is said to be *triply even* if the weight of each element of the code is a multiple of 8. In this talk, the ring of the weight enumerators of triply even codes containing all one vector is determined for small genera. The main ingredient is the invariant theory of the finite group. Let g be a positive integer. The weight enumerator in genus g has 2^g variables on which $GL(2^g, \mathbb{C})$ acts naturally. He found a finite group G_g an element of which preserves the weight enumerator of a triply even code. For small g, he expressed the invariant ring of G_g by the weight enumerators.

Day 3

At third day there were one invited speak session and two parallel session. The **ninth invited** session is from Dr. Fajar Yuliawan. He is from Institut Teknologi Bandung. This session was chaired by Prof. Nor Haniza Sarmin. This talk was about *Actions of hochschild cohomology and local duality in representation theory of finite groups*. Let G be a finite group and kG be the group algebra of G over a field k whose characteristic divides the order of G. Using a natural action of the group cohomology ring of kG on the homotopy category $\mathbb{K}(InjkG)$ of injective kG-modules, Benson, Iyengar, and Krause developed a local cohomology theory in 2008. Also in 2008, Benson and Greenlees proved a local duality theorem in this setting. He talked about an alternative action on the homotopy category $\mathbb{K}(InjkG)$ using the Hochschild cohomology ring of kG, and a local duality theorem with respect to this new action. He also talked about a relation between the action of the Hochschild cohomology and that of the group cohomology.

Then **fourth parallel session** was held after that. Room A was chaired by Prof. Ali Iranmanesh. Room B was chaired by Prof. Manabu Oura. This was second last parallel session.

The first talk at room A was from Dmitry Berdinsky. He is from Mahidol University, Thailand. His talk was about *Measuring closeness between cayley automatic groups and automatic groups*. In this talk, he introduced a way to estimate a level of closeness of Cayley automatic groups to the class of automatic groups using a certain numerical characteristic. He characterized Cayley automatic groups which are not automatic in terms of this numerical characteristic and then study it for the lamplighter group, the Baumslag-Solitar groups and the Heisenberg group.

Meanwhile, the first talk at room B was from Katrina Belleza. She is from University of San Carlos, Cebu City, Philippines. She talked about *The dual B-algebra*. She introduced and characterized the notion of a dual B-algebra. Moreover, this talked investigated the relationship between a dual B-algebra and BCK-algebra. Commutativity of a dual B-algebra is also discussed in this talk and its relation to some algebras such as CI-algebra, BCK-algebra, and dual BCI-algebra.

Afterward the second talk at room A was Nadir Trabelsi about *Groups whose proper subgroups have polycyclic-by-finite layers*. He is from University Setif 1, Algeria. Let G be a group and let X be a class of groups. G has X conjugacy classes or that it is an XC-group, if $G/C_G(x^G)$ belongs to X for every $x \in G$. Taking X to be the class F, C or PF of all finite, Chernikov or polycyclic-by-finite groups respectively, we obtain the familiar classes FC, CC

or $(PF)C$ respectively. Also if $m \in \mathbb{N} \cup \{\infty\}$, then the subgroup G_m generated by all elements of G of order m is called the m-layer of G. He stated that G is an XL-group, if all its layers belong to X. Among classes XL which have been studied, one can cite the classes FL, CL and $(PF)L$ which he obtained when he took for X the classes F, C and PF respectively. Clearly the class XL is contained in XC for the above classes X. Finally he conclude that G is minimal non-X if it is not an X-group while all its proper subgroups belong to X. In this talk, he gave the results obtained previously by several authors on minimal non-FC (respectively, non-CC, non-(PF)C, non-FL and non-CL) groups and a new one on minimal non-(PF)L groups.

Second talk at room B was about *Permutation codes over finite fields*. This talk was given by Irwansyah from Universitas Mataram, Indonesia. A code C of length n is called permutation codes or σ-code if it is invariant under the action of the subgroup $\langle\sigma\rangle \subseteq S_n$: $i.e.$: $\varphi(C) = C$ for all $\varphi \in \langle\sigma\rangle$ for some $\sigma \in S_n$. This class of codes is a generalization of two well-known codes, i.e. cyclic codes and quasi-cyclic codes. In this talk he described the structure of permutation codes via torsion submodules and ring decomposition using Chinese Remainder Theorem. Moreover, he gave some examples of optimal permutation codes over binary, ternary, and 5-ary.

After this session was also a parallel session. It was **fifth parallel session**. This parallel session is chaired by Prof. Kai Meng Tan. This session was different from another parallel session because there was only one room, which was room A.

The first speaker, Wahyu Ulyafandhie Misuki from Universitas Mataram spoke about *Non coprime graph of Dihedral groups and all its subgroup*. A graph is denoted by $G = (V, E)$, is a pair V and E, where V is a non-empty set containing vertices on the graph. A graph of group G where for each element in G is acting as a vertices, and two vertices u and v are connected when there are $(|u|, |v|) \neq 1$ is called non-coprime graph denoted as $\overline{\Gamma}_{G_{2n}}$. In this talk, he considered the shape and properties of non-coprime graphs produced in dihedral groups and all its subgroup were examined.

The second speaker, Manimaran from School of Advanced Sciences, VIT University, Vellore, India talked about *Some remarks on principal ideals of a rough monoid*. In this talk, he discussed the principal ideals of a commutative rough monoid of idempotents (T, Δ) and (T, ∇) and he gave the sufficient condition for the principal ideals of (T, Δ) and (T, ∇) also he described some of its properties with respect to the defined binary operations Δ and ∇ on the set of all rough sets T. He delineated these ideas through examples.

The third speaker, also the last speaker in this conference, Nabilah Fikriah Rahin from Universiti Teknologi Malaysia spoke about *The non-normal subgroup graph for some generalised quaternion groups*. A graph related to finite groups can be directed or undirected. The graph related to a subgroup

H of a group G is a directed graph with vertex set G and two distinct elements x and y are adjacent if $xy \in H$. In this talk, the non-normal subgroup graph of some generalised quaternion groups are constructed. In order to construct this graph, the non-normal subgroups of the generalised quaternion groups are first obtained.

Day 4

Excursion to NuArt Sculpture Park and Saung Angklung Udjo

NuArt Sculpture Park primarily exhibits the works of the sculptor Nyoman Nuarta that spans from the beginning of his career to the latest masterpieces.
The 3 hectares Park was specifically designed to nurture the development of Indonesian art, design & culture.

Saung Angklung Udjo is a cultural tourism destination and a complete education, because Saung Angklung Udjo own arena show, bamboo craft center and workshop for bamboo musical instruments. In addition, the presence of Saung Angklung Udjo in Bandung became more meaningful because of his concern to continue to preserve and develop the culture of Sunda - especially Angklung - to the public through the means of education and training

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