Titles and Abstracts

1. Junliang Cai, Beijing Normal University, P.R. China

Title: The Problem for Finding the Summation of p-series

Abstract: In the infinite series theory, p-series and its alternating series as follows

$$(1) \qquad \sigma(p) = \sum_{n\geq 1} \frac{1}{n^p}, \quad (p > 1); \qquad \tau(p) = \sum_{n\geq 1} \frac{(-1)^{n-1}}{n^p}, \quad (p \geq 1).$$

is a very important series. The convergence of the p-series has been solved long ago. But its summation has been the focus of attention.

In recent years, people have tried to settle even $p = 2k$. The summation of the series is not ideal, although progress is made.

The papers finally solves this problem and obtains a summation for even $p = 2k$-series, and a summation of its alternating series is given as follows.

$$(2) \qquad \tau(2k) = \frac{1}{2}\pi^{2k} M_k, \quad M_k = \sum_{l=1}^{k} \sum_{(j_1 j_2 \cdots j_l)_k} \frac{(-1)^{k+l}}{\prod_{i=1}^{l}(2j_i + 1)!},$$

where the summation is for all k-rank permutation of $(j_1 j_2 \cdots j_l)_k$.

Further, for all of the p, we also get the relationship between $\sigma(p)$ and $\tau(p)$ as

$$(3) \qquad \sigma(p) = \frac{2^{p-1}}{2^{p-1} - 1} \tau(p), \quad (p > 1).$$

In the end, we get a simpler improvement of M_k:

$$(4) \qquad M_k = \sum_{1\leq s\leq l\leq k} \sum_{\langle \mathbf{i} \rangle \in \mathscr{P}_{k,l}^{\langle s \rangle}} \frac{(-1)^{k+l} l!}{\mathbf{l}! \prod_{r=1}^{s} [(2i_r + 1)!]^{l_r}}.$$

where $\mathbf{l}! = l_1! l_2! \cdots l_s!$.

However, for the summation of the odd p-series and the p-series in more general situations, there is no visible sign of solution.

2. An Chang, Center of Discrete Mathematics, Fuzhou University, P.R. China

Title: A Motzkin-Straus type result for $\{m, m-1\}$ hypergraphs

Abstract: In 1965, Motzkin and Straus established a remarkable connection between the order of a maximum clique and a homogeneous polynomial of a graph. In the last decade, the tensor spectral theory of hypergraphs has been well developed due to its theoretical significance and applications in many disciplines. A general hypergraph is a pair $H = (V, E)$ consisting of a vertex set V and an edge set E which is a collection of subsets of V. The rank of H, denoted by $rank(H)$, is the maximum cardinality of the edges in E. In this talk, we first define a homogeneous polynomial for a general hypergraph, and then give a Motzkin-Straus type result for $\{m, m-1\}$ hypergraphs with rank m. We also give some lower and upper bounds on the spectral radius in terms of the clique number. This is the joint work with Yuan Hou and Lei Zhang.

3. Yichao Chen, Hunan University, P.R. China

Title: Genus Distributions of Linear Families of Graphs

Abstract: Linear graph familes (Called path-like graphs by Mohar) was introduced by Stahl in order to study the genus distributions of a graph. In this talk, we will show that the sequence of genus polynomials of any *H-linear family* of graphs satisfies a kth-order homogeneous linear recursion for some $k \geq 1$. The applications on real-rootedness and log-concavity of the genus polynomial will also discussed.

4. Gek L. Chia, Universiti Tunku Abdul Rahman, Sungai Long Campus, Cheras 43000 Kajang, Malaysia

Title: On Self-Clique Graphs

Abstract: Let G be a graph having neither loops nor multiple edges. By a *clique* of G we mean a maximal complete subgraph of G. The *clique graph* of G, denoted $K(G)$, is the graph whose vertex set is the set of cliques of G and two vertices are adjacent in $K(G)$ if and only if the corresponding cliques have non-empty intersection. A graph is *self-clique* if it is isomorphic to its clique graph. A brief account on self-clique graphs shall be given. Our focus is on the characterizations of self-clique graphs with given clique sizes.

5. Fengming Dong, Nanyang Technological University, Singapore

Title: Proof of Lundow and Markström's conjecture on chromatic polynomials via novel inequalities(Joint with Ge Jun, et al)

Abstract: It is well-known that for a graph $G = (V, E)$ of order n, its chromatic polynomial $P(G, x)$ can be expressed as $\sum_{i=1}^{n}(-1)^{n-i}a_i x^i$, where a_i's are non-negative integers. The number $\epsilon(G) = \sum_{i=1}^{n}(n-i)a_i / \sum_{i=1}^{n} a_i$ is the mean size of a broken-cycle-free spanning subgraph of G. Lundow and Markström conjectured that $\epsilon(T_n) < \epsilon(G) < \epsilon(K_n)$ holds for any connected graph G of order n which is neither a tree T_n of order n nor the complete graph K_n. In this talk, I will roughly introduce the techniques we used in the proof of this conjecture.

6. Mark N. Ellingham, Vanderbilt University, USA

Title: The orientable genus of complete tripartite graphs (Joint with D. Christopher Stephens and Xiaoya Zha)

Abstract: In 1969 White conjectured that the orientable genus of the complete tripartite graph $K_{\ell,m,n}$, with $\ell \geq m \geq n \geq 2$, is $g(K_{\ell,m,n}) = \lceil(\ell-2)(m+n-2)/2\rceil$. In 1976, Stahl and White similarly conjectured that the nonorientable genus is $\widetilde{g}(K_{\ell,m,n}) = \lceil(\ell-2)(m+n-2)/4\rceil$. The authors verified the nonorientable conjecture (which is true with three small exceptions) in 2006. This involved examining four cases based on the parity of m and n. We have recently completed the proof of the orientable conjecture. This involved examining sixteen cases, depending on the values of m and n modulo 4. Some of the cases required significantly more work than any

of the four nonorientable cases. We give an overall outline of the proof and discuss some of the techniques used.

7. Tao Feng, Beijing Jiaotong University, P.R. China

Title: Constructions for optimal Ferrers diagram rank-metric codes

Abstract: Optimal rank-metric codes in Ferrers diagrams can be used to construct good subspace codes. Such codes consist of matrices having zeros at certain fixed positions. This talk generalizes the known constructions for Ferrers diagram rank-metric (FDRM) codes. The known combining constructions for FDRM code are generalized by introducing the concept of proper combinations of Ferrers diagrams. Via a criteria for linear maximum rank distance (MRD) codes, an explicit construction for a class of systematic MRD codes is presented, which is used to produce new optimal FDRM codes. By exploring subcodes of Gabidulin codes, if each of the rightmost $\delta - 1$ columns in Ferrers diagram $\mathscr{F}$ has at least $n - r$ dots, where r is taken in a range, then the conditions that an FDRM code in $\mathscr{F}$ is optimal are established.

8. Jianfeng Hou, Center for Discrete Mathematics, Fuzhou University, P.R. China

Title: Bipartitions of oriented graphs

Abstract: Let $V(D) = X \cup Y$ be a bipartition of a directed graph D. We use $e(X, Y)$ to denote the number of arcs in D from X to Y. Motivated by a conjecture posed by Lee, Loh and Sudakov [Random Struct. Algorithms, 2016, 48: 147–170], we study bipartitions of oriented graphs. Let D be an oriented graph with m arcs. In this paper, it is proved that if the minimum degree of D is δ, then D admits a bipartition $V(D) = V_1 \cup V_2$ such that $\min\{e(V_1, V_2), e(V_2, V_1)\} \geq \left(\frac{\delta-1}{4\delta} + o(1)\right)m$. Moreover, if the minimum semidegree $d = \min\{\delta^+(D), \delta^-(D)\}$ of D is at least 21, then D admits a bipartition $V(D) = V_1 \cup V_2$ such that $\min\{e(V_1, V_2), e(V_2, V_1)\} \geq \left(\frac{d}{2(2d+1)} + o(1)\right)m$. Both bounds are asymptotically best possible.

9. Sun-Yuan Hsieh, Department of Computer Science and Information Engineering, National Cheng Kung University, Taiwan, P.R. China

Title: Approximation algorithms and inapproximability of hub allocation problems

Abstract: Given a metric graph $G = (V, E, w)$, a center $c \in V$, and an integer k, the **Star k-Hub Center Problem** is to find a depth-2 spanning tree T of G rooted by c such that c has exactly k children and the diameter of T is minimized. Those children of c in T are called hubs. A similar problem called the **Single Allocation k-Hub Center Problem** is to find a spanning subgraph H^* of G such that (i) C^* is a clique of size k in H^*; (ii) $V \backslash C^*$ forms an independent set in H^*; (iii) each $v \in V \backslash C^*$ is adjacent to exactly one vertex in C^*; and (iv) the diameter $D(H^*)$ is minimized. The vertices selected in C^* are called hubs and the rest of vertices are called non-hubs. Both **Star k-Hub Center Problem** and **Single Allocation k-Hub Center Problem** are NP-hard and have applications in transportation system, telecommunication system, and post mail system. In this talk, we give 5/3-approximation algorithms for both problems. Moreover, we prove that for any $\varepsilon > 0$, the **Star k-Hub Center Problem**

has no $(1.5-\varepsilon)$-approximation algorithm unless P = NP. Under the assumption P NP, for any $\varepsilon > 0$ the **Single Allocation k-Hub Center Problem** has no $(4/3-\varepsilon)$-approximation algorithm.

10. Zhiquan Hu, Faculty of Math & Statistics, Central China Normal University, Wuhan, P.R. China

Title: Long Cycles Passing Through Given Elements in a Graph

Abstract: In this talk, we show some results on long cycles through given elements in a graph. In particular, we consider the following problem proposed by Locke and Zhang in [Graphs and Combinatorics 7 (1991) 265-269]: Let G be a k-connected graph with minimum degree d and X a set of m vertices on a cycle of G. For which values of m and k, with $m > k \geq 2$, must G have a cycle of length at least $\min\{2d, |V(G)|\}$ passing through X? Fujisawa and Yamashita solved this problem for the case $k \geq 3$ and $m = k+1$ in [Journal of Graph Theory 58 (2008), 179-190]. We provide an affirmative answer to this problem for the case of $k \geq 3$ and $k+1 \leq m \leq \lfloor \frac{4k+1}{3} \rfloor$. This is a joint work with Feifei Song.

11. Lijun Ji, Department of Mathematics, Soochow University, P.R. China

Title: Existence of H designs

Abstract: An $\mathrm{H}(m, g, K, 3)$ design is a triple $(X, \mathscr{T}, \mathscr{B})$, where X is a set of mg points, $\mathscr{T}$ is a partition of X into m disjoint sets of size g and $\mathscr{B}$ is a set of transverses of $\mathscr{T}$ with cardinality from the set K, such that each 3-element transverse of $\mathscr{T}$ is contained in exactly one of them. In 1990, Mills determined the existence of an $\mathrm{H}(m, g, 4, 3)$ design with $m \neq 5$. In this talk, we give the the necessary and sufficient conditions for the existence an $\mathrm{H}(m, g, 4, 3)$ design and related designs.

12. Khee Meng Koh, Engineering Systems and Design, Singapore University of Technology and Design, Singapore

Title: On Power Domination in Graphs

Abstract: The power domination problem is to find the minimum number of phase measurement units (PMUs) that will observe the state of the entire electric system. The working principles of these units are based on Ohm's law and Kirchoff's current law. Using graph theory terminology, a PMU observes the vertex at which it is placed and its incident edges and their ends. The following observation rules are deduced from the above two physics laws:

1. Any vertex that is incident to an observed edge is observed.
2. Any edge joining two observed vertices is observed.
3. For $k = 2$, if a vertex is incident to k edges such that $k-1$ of these edges are observed, then all k of these edges are observed.

Let G be a graph with vertex set V. A set $S \subseteq V$ is called a *power dominating set* (PDS) of G if every vertex and every edge in G are observed by S after applying the above observation rules. The *power domination number* $\gamma_p(G)$ is the minimum cardinality of a PDS of G. A *zero forcing set* for a graph G is a set of vertices

B such that when initially the vertices in B are colored black and the vertices in $V \backslash B$ are colored white, all the vertices of G eventually become black by the repeated application of the following *color-change rule*: "If u is a black vertex and exactly one neighbor w of u is white, then change the color of w to black". The *zero forcing number* of G, denoted by $Z(G)$, is the minimum cardinality of a zero forcing set of G. In this talk, we first present some existing results about $\gamma_p(G)$, then proceed to introduce a result relating $\gamma_p(G)$ and $Z(G)$, and finally see that this latter result could have some applications for finding $\gamma_p(G \Box H)$, for some graphs G and H, where $G \Box H$ denotes their Cartesian product.

13. István Kovács, University of Primorska, Slovenia

Title: Testing isomorphism of cyclic symmetric configurations (*Joint work with* Hiroki Koike, Dragan Marušič and Mikhail Muzychuk)

Abstract: For a set of points $X = \{r_1, r_2, \ldots, r_n\}$ in the Euclidean plane $\mathbb{R}^2$, a positive constant l and some stock pieces of length L ($l \leq L$), where the cost of each Steiner point used is c_1, and the selling price of each stock piece is c_3, it is asked to construct a Steiner tree T interconnecting the terminals such that each edge in the tree T has a length no more than l, the new objective is to minimize the total construction cost to construct such a Steiner tree T, i.e.,

$$\min_T \{c_1 k_1(T) + c_2 \sum_{e \in T} w(e) + c_3 k_3(T)\}$$

where $k_1(T)$ is the number of Steiner points used, c_2 is a construction cost of per unit length, $k_3(T)$ is the number of necessary stock pieces of length L to construct all edges in such a Steiner tree T.

In this talk, we present two approximation algorithms with performance ratios 4 and 3 to solve this new variant of the Steiner tree problem.

14. Young Soo Kwon, Yeungnam University, Kyeongsan, Republic of Korea

Title: Classification of t-balanced regular Cayley maps on some groups

Abstract: In this talk, we will consider t-balanced regular Cayley maps on semidirect product of $\mathbb{Z}_n$ and $\mathbb{Z}_2$. It is well-known that any semidirect product of $\mathbb{Z}_n$ and $\mathbb{Z}_2$ is isomorphic to the group $\langle a, b \mid a^n = b^2 = 1,\ ba = a^r b\rangle$ for some r satisfying $r^2 \equiv 1(\mod n)$. We denote this group by $\Gamma(n, r)$. If $r = 1$ and -1, then $\Gamma(n, r)$ is isomorphic to $\mathbb{Z}_n \times \mathbb{Z}_2$ and dibedral group of order $2n$, respectively. For a positive integer $n = 4m$ divided by 4, if $r = 2m - 1$, then $\Gamma(n, r)$ is called semi-dihedral group. For dihedral groups and semi-dihedral groups, t-balanced regular Cayley maps on these groups were classified in [1] and [2]. In this talk, for arbitrary r satisfying $r^2 \equiv 1(\mod n)$, we consider the classification of t-balanced regular Cayley maps on $\Gamma(n, r)$.

References

[1] J.H. Kwak, Y.S. Kwon, R. Feng, A classification of regular t-balanced Cayley maps on dihedral groups. *European J. Combin.* **27(3)** (2006) 382–392.

[2] J.M. Oh, A classification of regular t-balanced Cayley maps on semi-dihedral groups. *J. Combin. Theory Ser. B* **99** (2009) 480–493.

15. Hong-Jian Lai, West Virginia University, USA

Title: Some progresses of studies of group connectivity and modulo orientations of graphs

Abstract: When investigating the 4-color problem, Bill Tutte in the 1950s introduced the theory of nowhere zero flows, and proposed the most fascinating flow conjectures of graphs. These conjectures are still open as of today. In 1992, Jaeger, Linial, Payan and Tarsi in JCTB proposed the non-homogeneous version of the nowhere zero flow problem, which is now known as the group connectivity problem of graphs. Tutte indicated that the nowhere zero 3-flow problem is equivalent to the modulo 3 orientation problem. The corresponding non homogeneous version of modulo orientation, now known as the strongly group connectivity problem, was proposed in 2007. In this talk, we will introduce these problems and report some of the recent progresses of these problems.

16. Jaeun Lee, Yeungnam University, Korea

Title: On Cayley graphs

Abstract: In this talk, we will discuss on the enumeration, domonation and embedding problems on Cayley graphs.

17. Tongyin Liu, Liberty Mutual Group, USA

Title: An Introduction to Catastrophe Risk Modelling and Portfolio Management in Property and Casualty Insurance Industry

Abstract: Catastrophe risk has become an increasing focus in risk management in P&C industry since Hurricane Katrina in 2005. A brief introduction on catastrophe modeling will be presented. Current catastrophe model methodologies and discusses on how catastrophic risk is quantified in portfolio optimization are also covered.

18. Wenzhong Liu, College of Science, Nanjing University of Aeronautics & Astronautics, Nanjing, P.R. China

Title: Even cycle decompositions of the line graphs of cubic graphs

Abstract: An even cycle decomposition of a graph is a partition of edges into even cycles. Markström conjectured that the line graph of a 2-connected cubic graph has an even cycle decomposition and proved the conjecture for 2-connected cubic graphs with oddness at most 2. However for 2-connected cubic graphs with oddness 2, Markström's proof does not cover such graphs without 2-factors consisting of only induced cycles. In the paper, we construct infinitely many 2-connected cubic graphs with oddness 2 and no 2-factors consisting of only induced cycles. Further we prove that the conjecture holds for 2-connected cubic graphs with oddness at most 4.

This is a joint work with Huazheng You.

19. Yanpei Liu, Beijing Jiaotong University, P.R. China

Title: Programs Delivered from Combinatorics and Graph Theory: Backgrounds and Progresses

Abstract: These programs updated for two times. The first time seen in Selected Publications of Y.P. Liu(or in brief, Selections, pp.11671-11729). The second time in Semi-empty Collections of Mathematics(or Collections, pp.10714-10773). After verification one by one, a number of confirmative updates and new progresses are complimented. Notably, the qualitative and quan titative theories of all the meson functional equations with constant parameters in Programs 76101 and Programs 166185 are established in the extension of an integral domain for the stage of systematization in theory. I do hope, but be afraid, whether or not to see a program completed in all the three stages: systematization for theory, efficientization for running and intelligentization for usages.

20. Sheng-Lung Peng, Department of Computer Science and Information Engineering, National Dong Hwa University, Hualien 974, Taiwan, P.R. China

Title: Algorithmic Aspects of b-Disjunctive Total Domination in Graphs

Abstract: For a graph $G = (V, E)$, $D \subseteq V$ is a dominating set if every vertex in $V \setminus D$ has a neighbor in D. If every vertex in V has to be adjacent to a vertex of D, then D is called a total dominating set of G. The (total) domination problem on G is to find a (total) dominating set D of the minimum cardinality. The (total) domination problem has been studied for a long time. Recently, the following variant is proposed. Vertex subset D is a b-disjunctive total dominating set if every vertex of V is adjacent to a vertex of D or has at least b vertices in D at distance 2 from it. The b-disjunctive total domination problem on G is to find a b-disjunctive total dominating set D of the minimum cardinality. In this talk, we present some results of the b-disjunctive total domination problem.

21. Moo Young Sohn, Department of Mathematics, Changwon National University, 641-773, Changwon, Korea

Title: Some characterizations for trees with equal strong Roman domination number and Roman domination number

Abstract: A graph theoretical model called Roman domination in graphs originates from the historical background that any undefended place(with no legions) of the Roman Empire must be protected by a stronger neighbor place (having two legions). A Roman dominating function for a graph $G = (V, E)$, is a function $f : V \to \{0, 1, 2\}$ such that every vertex v with $f(v) = 0$ has at least a neighbor w in G for which $f(w) = 2$. The Roman domination number of a graph is the minimum weight, $\sum_{v \in V} f(v)$, of a Roman dominating function. In order to deal a problem of a Roman domination-type defensive strategy under multiple simultaneous attacks, Álvarez-Ruiz et al. [Discrete Applied Math. 2017] initiated the study of a new parameter related to Roman dominating function, which is called strong Roman domination. In this talk, we classify a family of trees with equal strong Roman dominance number and Roman dominance number.

22. Zi-Xia Song, Department of Mathematics, University of Central Florida, USA

Title: Multicolor Gallai-Ramsey Numbers of Cycles and Paths

Abstract: Classical Ramsey theory dates back to the 1930's and computing Ramsey numbers is a notoriously difficult problem in combinatorics. We study Ramsey numbers of graphs in Gallai colorings, where a Gallai coloring is a coloring of the edges of a complete graph such that no triangle has all its edges colored differently. Given an integer $k \geq 1$ and graphs $H_1, \ldots, H_k$, the Gallai-Ramsey number $GR(H_1, \ldots, H_k)$ is the least integer n such that every Gallai coloring of the complete graph K_n using k colors contains a monochromatic copy of H_i in color i for some $i \in \{1, \ldots, k\}$. Gallai-Ramsey numbers are more well-behaved, though computing them is far from trivial. In this talk, I will present our recent results on Gallai-Ramsey numbers of cycles and paths.

This is joint work with Christian Bosse and Jingmei Zhang.

23. Richard Sun, Cisco Systems, USA

Title: Graph Theory Applications in Optical Network Design

Abstract: Dense wavelength division multiplexing (DWDM) technology allows transport of multiple colors in a single fiber. For DWDM to work, many optical modules are required, including amplifiers, dispersion-compensating modules (DCM), add-drop multiplexers, and transponders. The network design process typically starts with a given network topology (i.e. a graph), and a set of point-to-point demands. Demands may need different number of routing paths depending on the protection requirements. The objective is to find best routing paths for all demands with minimum number of optical modules, subject to optical transport requirements for each route. In this talk, we will discuss some network design models in terms of graphs, including amplifier/DCM placement, ring routing, and transponder placements.

24. Erling Wei, Renmin University of China, P.R. China

Title: Homeomorphically Irreducible Spanning Trees in Cubic Hexagulations of Surfaces

Abstract: A homeomorphically irreducible spanning tree (HIST) of a connected graph is a spanning tree without vertices of degree two. The determination of the existence problem of a homeomorphically irreducible spanning tree in a plane cubic graph is NP-complete. A hexagulation of a surface is a cubic graph embedded on a surface such that every face is bounded by a hexagon. It is a problem asked by Hoffmann-Ostenhof and Ozeki that whether there are finitely or infinitely many hexagulations of torus with homeomorphically irreducible spanning trees. In this paper, we show that a family of hexagulations of the surface, denoted by $H(m, n)$ with $m \geq 4$ being even and $n \geq 2$, have a homeomorphically irreducible spanning tree if and only if $m \equiv 2 \pmod 4$, which settles the problem of Hoffmann-Ostenhof and Ozeki.

This is joint work with Shaohui Zhai, Jinghua He and Dong Ye.

25. Baoyindureng Wu, College of Mathematics and System Science, Xinjiang University, Urumqi 830046, China

Title: Domination and 2-packing of a graph(joint with Yin Chen and Yanhua Zhao)

Abstract: Let G be a graph. A set $S \subseteq V(G)$ is a dominating set of G if each vertex $v \in V(G) \setminus S$ is adjacent to a vertex of S in G. The domination number of G, denoted by $\gamma(G)$, is the cardinality of a minimum dominating set of G. We say $S \subseteq V(G)$ a 2-packing of G if $d(u,v) \geq 3$ for any two distinct vertices u, v of S. The packing number of G, denoted by $\rho(G)$, is the cardinality of a maximum 2-packing of G. Note that for any graph G, $\rho(G) \leq \gamma(G)$. Our main concern is to seek the graphs G with $\rho(G) = \gamma(G)$. 1975, Meir and Moon proved that trees are such kinds of graphs. We show that this family of graphs includes chordal graphs with diameter 2, threshold graphs, interval graphs. A graph G is called $\gamma\rho$-perfect if $\gamma(H) = \rho(H)$ for any induced subgraph H of G. We characterize all $\gamma\rho$-perfect line graphs.

26. Liming Xiong, Beijing Institute of Technology, Beijing, P.R. China

Title: Forbidden subgraphs and properties of supereulerian (hamiltonain) graphs

Abstract: In this talk, we shall present some relationship between a set of forbidden subgraphs and supereulerian (hamiltonian) graphs.

27. Bo Zhou, School of Mathematical Sciences, South China Normal University, Guangzhou 510631, P. R. China

Title: On the distance spectral radius

Abstract: The distance spectral radius of a connected graph G is the greatest eigenvalue of the distance matrix of G. We discuss properties on distance spectral radius, including the behaviour of the distance spectral radius under transformations and extremal results.