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# ICTP-IPM Workshop and Conference in Combinatorics and Graph Theory

**03 - 14 September 2012**
**Trieste - ITALY**

# List of Abstracts

# ICTP/IPM Workshop and Conference in Combinatorics and Graph Theory

3 - 14 September 2012

## Abstracts of Contributed Talks

**Speaker and Institution:** Eric Ould Dadah Andriantiana, Stellenbosch University, South Africa

**Title:** Energy, Hosoya index and Merrifield-Simmons index of trees with prescribed degree sequence

**Abstract:** The energy of a graph, defined as the sum of the absolute values of its eigenvalues, the number of independent edge subsets (known as Hosoya index) and the number of independent vertex subsets (called Merrifield-Simmons index) are three closely related graph invariants that are studied in mathematical chemistry. We characterize the unique (up to isomorphism) tree which has a given degree sequence, minimum energy and Hosoya index and maximum Merrifield-Simmons index. We also compare trees with different degree sequences. Various known results follow as simple corollaries from our main theorem.

**Speaker and Institution:** Alireza Abdollahi, University of Isfahan, Iran

**Title:** Integral Cayley graphs]Non-complete multipartite connected Cayley integral graphs on finite groups

**Abstract:** Let $G$ be a nontrivial finite group, $S \subseteq G \setminus \{e\}$ be a set such that if $a \in S$, then $a^{-1} \in S$ and $e$ be the identity element of $G$. Suppose that $\Gamma(S : G)$ is the Cayley graph with vertex set $G$ such that two vertices $a$ and $b$ are adjacent whenever $ab^{-1} \in S$. An arbitrary graph is called integral whenever all eigenvalues of the adjacency matrix are integers. We say that a group $G$ is Cayley integral simple group (or for short a CIS-group) whenever every connected Cayley graph on $G$ is isomorphic to a complete multipartite graph. In this paper we prove that if $G$ is a non-simple group, then $G$ is Cayley integral simple if and only if $G$ is conjugate to $\mathbf{Z}_{p^2}$ for some prime number $p$ or $G$ is conjugate to $\mathbf{Z}_2 \times \mathbf{Z}_2$. Meanwhile we show that if $G$ is a simple group, then maybe it is not a CIS-group.

**Speaker and Institution:** Patrick Ali, University of KwaZulu-Natal, South Africa

**Title:** Steiner Diameter of 4 and 5-Connected Maximal Planar Graphs

**Abstract:** Let $G$ be a connected graph of order $p$ and $S$ a nonempty set of vertices of $G$. Then the Steiner distance $d(S)$ of $S$ is the minimum size of a connected subgraph of $G$ whose vertex set contains $S$. If $n$ is an integer, $2 \leq n \leq p$, the Steiner $n$-diameter, $diam_n(G)$, of $G$ is the maximum Steiner distance of any $n$-subset of vertices of $G$. This is a generalisation of the ordinary diameter, which is the case $n = 2$. We give an upper bound on the Steiner $n$-diameter of a 4-connected maximal planar graph of given order. Moreover, we construct graphs to show that the bounds are asymptotically sharp. Furthermore we extend this result to 5-connected maximal planar graphs.

**Speaker and Institution:** Saeid Alikhani, Yazd University, Iran

**Title:** On the domination polynomial of Dutch Windmill graphs

**Abstract:** Let $G$ be a simple graph of order $n$. The domination polynomial of $G$ is the polynomial $D(G, \lambda) = \sum_{i=0}^{n} d(G, i)\lambda^i$, where $d(G, i)$ is the number of dominating sets of $G$ of size $i$. Every root of $D(G, \lambda)$ is called the domination root of $G$. In this talk we consider the graphs obtained by selecting one vertex in each of $n$ triangles and identifying them. Some call them Dutch Windmill Graphs. We show that no nonzero real number is domination root of these kind of graphs. Also we show that there are some of these kind of graphs whose complex domination roots have positive real part. Also we study the domination polynomial of other classes of graphs related to Dutch Windmill graphs.

**Speaker and Institution:** Meysam Alishahi, Shahrood University of Technology, Iran

**Title:** Dynamic Chromatic Number of Regular Graphs

**Abstract:** A $k$-dynamic coloring of a graph $G$ is a proper coloring of $G$ with $k$ colors such that for every vertex $v \in V(G)$ of degree at least 2, the neighbors of $v$ receive at least 2 colors. The dynamic chromatic number of a graph $G$, $\chi_2(G)$, is the least number $k$ such that $G$ admits a $k$-dynamic coloring. It was conjectured [B. Montgomery. *Dynamic coloring of graphs.* PhD thesis, West Virginia University, 2001.] that if $G$ is a $k$-regular graph, then $\chi_2(G) - \chi(G) \leq 2$. In this talk, we prove that if $G$ is a $k$-regular graph with $\chi(G) \geq 4$, then $\chi_2(G) \leq \chi(G) + \alpha(G^2)$. It confirms the conjecture for all regular graphs with diameter at most 2 and chromatic number at least

4. In fact, it shows that $\chi_2(G) - \chi(G) \leq 1$ provided that $G$ has diameter at most 2 and $\chi(G) \geq 4$. Moreover, we show that for any $k$-regular graph $G$, $\chi_2(G) - \chi(G) \leq \lfloor 14.6 \ln k \rfloor + 1$. Also, we show that for any $n$ there exists a regular graph $G$ whose chromatic number is $n$ and $\chi_2(G) - \chi(G) \geq 1$. This result gives a negative answer to a conjecture of [A. Ahadi, S. Akbari, A. Dehghan, and M. Ghanbari, On the difference between chromatic number and dynamic chromatic number of graphs. *Discrete Math.*, In press].

**Speaker and Institution:** Firouzeh Ashraf, Isfahan University of Technology, Iran

**Title:** Sum of the two largest signless Laplacian eigenvalues of a graph

**Abstract:** Let $G$ be a graph with $e$ edges and let $q_1$ and $q_2$ be the two largest signless Laplacian eigenvalues of $G$. We prove that $q_1 + q_2 \leq e + 3$. This is a joint work with G.R. Omidi and B. Tayfeh-Rezaie.

**Speaker and Institution**: Edy Tri Baskoro, Institut Teknologi Bandung (ITB), Indonesia

**Title:** On the locating-chromatic number of a corona product of two graphs

**Abstract:**

The locating-chromatic number of a graph $G$ can be defined as the cardinality of a minimum ordered partition $\Pi$ of the vertex-set $V(G)$ such that all vertices in $G$ have different coordinates with respect to $\Pi$ and every two adjacent vertices in $G$ are not in the same partition class. In this case, the coordinate of a vertex $v$ consists of the distances from vertex $v$ to the ordered partition classes in $\Pi$. In this paper, we discuss the locating-chromatic number for a graph obtained by a corona product of two graphs.

**Speaker and Institution:** Faqir M. Bhatti, Lahore University of Management Science (LUMS), Pakistan

**Title:** Spectral Properties of He Matrix of Inner Dual Graph of Honeycomb Lattice.

**Abstract:** The main purpose of this talk is to present various properties of the inner dual graph of honeycomb lattice using the He matrix, which was first introduced by He and He in 1985. The spectral properties of He matrix will be another focus of this talk. We argue mathematically that the spectrum of He matrix is different from (0,1) matrices and it gives important properties in terms of rotations and reflections of honeycomb lattice. Another study which we present here is about the energy of graphs. What is the effect of concatenation and coalescence on the eigenvalues and energy of inner dual graph? We give various inequalities for the same.

**Speaker and Institution:** Peter Borg, University of Malta

**Title:** Chvátal's conjecture and some other intersection conjectures

**Abstract:** A family $\mathcal{H}$ of sets is said to be *hereditary* if all subsets of any set in $\mathcal{H}$ are in $\mathcal{H}$; thus, a family is hereditary if and only if it is a union of power sets. A family $\mathcal{A}$ is said to be *intersecting* if any two sets in $\mathcal{A}$ intersect. A *star* is a family whose sets contain at least one common element; thus, a star is trivially intersecting. An outstanding open conjecture in extremal set theory is due to Chvátal and claims that *among the largest intersecting sub-families of any finite hereditary family there is a star.* In this talk we will discuss some work done on this conjecture and present a weighted version that generalises both this conjecture and a conjecture on intersecting families of *signed sets*. We will also present some conjectures for *cross-intersecting* ($\mathcal{A}_1, \mathcal{A}_2, \ldots, \mathcal{A}_k$ of sets are said to be *cross-intersecting* if for any $i$ and $j$ in $\{1, 2, \ldots, k\}$ with $i \neq j$, any set in $\mathcal{A}_i$ intersects any set in $\mathcal{A}_j$) sub-families of hereditary families that also generalise Chvátal's conjecture.

**Speaker and Institution:** Péter Csikvári, Eötvös Loránd University, Hungary

**Title:** Benjamini–Schramm continuity of root moments of graph polynomials

**Abstract:** Recently, M. Abért and T. Hubai studied the following problem. The chromatic measure of a finite simple graph is defined to be the uniform distribution on its chromatic roots. Abért and Hubai proved that for a Benjamini-Schramm convergent sequence of finite graphs, the chromatic measures converge in holomorphic moments. They also showed that the normalized log of the chromatic polynomial converges to a harmonic real function outside a bounded disc.

In this talk we generalize their work to a wide class of graph polynomials, namely, multiplicative graph polynomials of bounded exponential type. A special case of our results is that for any fixed complex number $v_0$ the measures arising from the Tutte polynomial $Z_{G_n}(z, v_0)$ converge in holomorphic moments if the sequence $(G_n)$ of finite graphs is Benjamini–Schramm convergent. This answers a question of Abért and Hubai in the affirmative. (Joint work with Péter E. Frenkel, Eötvös Loránd University, Budapest.)

**Speaker and Institution:** Cristina Dalfo, Universitat Politecnica de Catalunya

**Title:** Edge-distance-regular graph are distance-regular

**Abstract:** A graph is edge-distance-regular when it is distance-regular around each of its edges and it has the same intersection numbers for any edge taken as a root. In this talk we give some ideas of the (combinatorial and algebraic) proofs of the fact that every edge-distance-regular graph $G$ is distance-regular and homogeneous. More precisely, $G$ is a bipartite distance-regular or a generalized odd graph. Also, we show the relationships between some of their corresponding parameters, mainly, the distance polynomials and the intersection numbers. (This is joint work with M. Cámara, C. Delorme, M.A. Fiol, and H. Suzuki)

**Speaker and Institution:** Chaim Even-Zohar, The Hebrew University of Jerusalem, Israel

**Title:** Compression methods and sums of sets in $\mathbf{Z}_2^n$

**Abstract:** Denote by $F(K)$ the maximum of $|span(A)|/|A|$, over all subsets $A$ of $\mathbf{Z}_2^n$ with $|A+A|/|A| < K$. Using methods of subset compression, Green and Tao and Konyagin found $F(K) = \Theta(poly(K)4^K)$. Elaborating on these methods, we explicitly calculate $F(K)$, and in particular show that it is $\Theta(4^K/K)$. More generally, we give a tight lower bound on $|A+B|$, where $A$ and $B$ are two generating subsets of $\mathbf{Z}_2^n$ of prescribed cardinalities.

**Speaker and Institution:** Bahman Ghandchi, IASBS, Iran

**Title:** Graph Minor Theory

**Abstract:** A Graph $H$ is called a minor of graph $G$ if it can be obtained from $G$ by a series of vertex and edge deletions and edge contractions. The most interesting problem in Graph Minor Theory is Hadwiger's conjecture. The conjecture is considered as one of the most important open problems in graph theory by many mathematicians. It states that every graph $G$ has the graph $K_{\chi(G)}$ as a minor. The other interesting part of Graph Minor Theory is searching for extremal bounds, i.e. finding a bound on edge density that forces the graph to have certain graphs as minor. This began with work of Mader which proved that for every graph $H$ there is a constant $C_H$ that every graph $G$ satisfing $|E(G)| \geq C_H|V(G)|$ contains $H$ as a minor.

**Speaker and Institution:** Samira Hossein Ghorban, Institute for Research in Fundamental Sciences (IPM), Iran

**Title:** A sketchy look at the rank of a graph

**Abstract:** In this talk, I intend to look at the rank problem of a graph. The rank of a graph is defined to be the rank of its adjacency matrix. A graph is called reduced if it has no isolated vertex and no two vertices with the same set of neighborhoods. A reduced graph is said to be maximal if it is not a proper subgraph of a reduced graph with the same rank. First, I give a brief review of the state of art of the problem. But the main point of this talk is to look at the different structures of maximal graphs of a given rank. There are three constructions due to Elingam and I present three more constructions of maximal graphs.

**Speaker and Institution:** Ebrahim Ghorbani, K.N. Toosi University of Technology and IPM, Iran

**Title:** Maximum order of triangle-free graphs with a given rank

**Abstract:** The rank of a graph is defined to be the rank of its adjacency matrix. A graph is called reduced if it has no isolated vertices and no two vertices with the same set of neighbors. We determine the maximum order of reduced triangle-free graphs with a given rank and characterize all such graphs achieving the maximum order. This is a joint work with A. Mohammadian and B. Tayfeh-Rezaie.

**Speaker and Institution:** Andrzej Grzesik, Jagiellonian Univeristy, Poland

**Title:** Flag Algebra calculus

**Abstract:** During the talk we will make introduction to the powerful Razborov theory of flag algebras and present applications of this theory to extremal combinatorics. In particular, we will present a sketch of the proof of the Erdos conjecture about the maximal number of five-cycles in triangle-free graphs.

**Speaker and Institution:** Xian'an Jin, Xiamen University

**Title:** The computation of the Jones polynomial and its zeros

**Abstract:** In this talk, I will first give a brief introduction to knot theory, in particular the correspondence between links and graphs, the Jones polynomial of links and the Tutte polynomial of signed graphs. Then I present a formula for computing the Tutte polynomial of the signed graph formed from a labeled graph by edge replacements in terms of the chain polynomial of the labeled graph. Finally using the above formula, Beraha-Kahane-Weiss's theorem and Sokal's lemma, I give some theorems on zeros of the Jones polynomial including the unit-circle theorem and the density-in-the-plane theorem. (This is a joint work with Fuji Zhang, Fengming Dong and Eng Guan Tay)

**Speaker and Institution:** S. Khalashi Ghezelahmad, Iran University of Science and Technology (with S. Akbari and H.A. Tavallaee)

**Title:** Some Results on the Clique Number of the Intersection Graph of Submodules of a Module

**Abstract:** Let $R$ be a ring with identity and $M$ be a unitary left $R$-module. The intersection graph of an $R$-module $M$, denoted by $G(M)$, is defined to be a graph whose vertices are in one to one correspondence with all non-trivial submodules of $M$ and two distinct vertices are adjacent if and only if the corresponding submodules of $M$ have non-zero intersection. In this talk, we investigate the interplay between the module-theoretic properties of $M$ and the graph-theoretic properties of $G(M)$. We determine the diameter and the girth of $G(M)$. Also the clique number and the chromatic number of $G(M)$ are studied. It is shown that, if $\omega(G(M))$, the clique number of $G(M)$, is finite, then $\chi(G(M))$ is finite, where $\chi(G(M))$ denotes the chromatic number of $G(M)$. We prove that if $1 < \omega(G(M)) < \infty$, then $M$ is the direct sum of a finite module and a cyclic module. In addition, it is shown that if $\omega(G(M)) = \infty$, then $M$ contains an infinite clique. Finally, we give conditions under which $\omega(G(M)) < \infty$, implies that $\omega(G(R)) < \infty$, where $G(R)$ is the intersection graph of left ideals of $R$.

**Speaker and Institution:** Niraj Khare, Texas A & M, Doha (Qatar)

**Title:** Cardinality of an edge set (or a hyper-edge set) of a graph (or a hypergraph) under restrictions

**Abstract:** One of the open problems, due to Paul Erdös, concerns with cardinality of a set system under constraints. This problem known as: Sunflower Lemma bound, remains open since 1960. We consider Sunflower Lemma's graph theoretic specialization and subsequent generalization to other extremal graph and hypergraph problems. This talk provides sharp bounds for the maximum number of edges possible in a simple graph with restricted values of two of the three parameters, namely, maximum matching size, independence number and maximum degree. We also construct extremal graphs that achieve the edge bounds in all cases. We further establish uniqueness of

these extremal graphs whenever they are unique. We will also provide some other results on cardinality of edge set of a graph that generalize a previously known result due to Erdos and Gallai. A best possible bound on the size of a 3-uniform linear set system with restricted matching size and maximum degree will be discussed. The work is inspired by series of previous work on extremal graphs and set systems by V.Chvátal and D.Hanson, H.L.Abbott, D.Hanson and N. Sauer, Balachandran and Khare, P. Erdős and Gallai, J. Akiyama and P. Frankl.

**Speaker and Institution:** Michal Lason, Jagiellonian University, Poland

**Title:** On-line list coloring of matroids

**Abstract:** We will give a necessary and sufficient condition for a matroid to be colorable from any lists of fixed size. This extends a theorem of Seymour asserting that if matroid is colorable with k colors then it is also colorable from arbitrary lists of size k. We will derive some basis exchange properties and using them show that colorability of a matroid from any lists of fixed size implies on-line list colorability.

**Speaker and Institution:** Shabnam Malik, Forman Christian College, Pakistan.

**Title:** Hamiltonian Cycles in Directed Toeplitz Graphs:

**Abstract:** A *Toeplitz matrix*, named so after Otto Toeplitz (1881-1940), is a square matrix which has constant values along all diagonals parallel to the main diagonal, i.e., a matrix of the form

$$\begin{matrix} a_0 & a_1 & a_2 & \cdots & a_{n-2} & a_{n-1} \\ a_{-1} & a_0 & a_1 & \cdots & a_{n-3} & a_{n-2} \\ a_{-2} & a_{-1} & a_0 & \cdots & a_{n-4} & a_{n-3} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ a_{-n+1} & a_{-n+2} & a_{-n+3} & \cdots & a_{-1} & a_0 \end{matrix}$$

A directed Toeplitz graph is a digraph with Toeplitz adjacency matrix. In this talk I will discuss conditions for the existence of hamiltonian cycles in directed Toeplitz graphs, and for some cases will discuss the traceable and hamiltonian connectedness.

**Notation:** The main diagonal of an $(n \times n)$ Toeplitz adjacency matrix will be labeled 0 and it contains only zeros. The $n-1$ distinct diagonals above the main diagonal will be labeled $1, 2, \ldots, n-1$ and those under the

main diagonal will also be labeled 1, 2, $\ldots, n-1$. Let $s_1$, $s_2, \ldots, s_k$ be the upper diagonals containing ones and $t_1$, $t_2, \ldots, t_l$ be the lower diagonals containing ones, such that $0 < s_1 < s_2 < \ldots < s_k < n$ and $0 < t_1 < t_2 < \ldots < t_l < n$. Then, the corresponding Toeplitz graph will be denoted by $T_n\langle s_1, s_2, \ldots, s_k; t_1, t_2, \ldots, t_l\rangle$. That is, $T_n\langle s_1, s_2, \ldots, s_k; t_1, t_2, \ldots, t_l\rangle$ is the graph with vertices 1, 2, $\ldots, n$, in which the edge $(i, j)$ occurs if and only if $j - i = s_p$ or $i - j = t_q$ for some $p$ and $q$ ($1 \leq p \leq k$, $1 \leq q \leq l$).

**Speaker and Institution:** Ali Mohammadian, Institute for Research in Fundamental Sciences (IPM), Iran

**Title:** The Nullity of Integral Trees

**Abstract:** The nullity of a graph $G$ is the nullity of its adjacency matrix $\mathcal{A}(G)$, that is, the multiplicity of 0 as an eigenvalue of $\mathcal{A}(G)$. A graph $G$ is called integral if all eigenvalues of $\mathcal{A}(G)$ consist entirely of integers. In this talk, we are concerned with integral trees. These objects are extremely rare and very difficult to find. We show that for every integer $k \geq 2$, there are only finitely many integral trees with nullity $k$. We also characterize all integral trees with nullity at most 3.

**Speaker and Institution:** G.R. Omidi, Isfahan University of Technology, Iran

**Title:** Around a Conjecture of Erdős on graph Ramsey numbers

**Abstract:** For given graphs $G_1$ and $G_2$ the *Ramsey number* $R(G_1, G_2)$, is the smallest positive integer $n$ such that each blue-red edge coloring of the complete graph $K_n$ contains a blue copy of $G_1$ or a red copy of $G_2$. In 1983, Erdős conjectured that there is an absolute constant $c$ such that $R(G) = R(G, G) \leq 2^{c\sqrt{m}}$ for any graph $G$ with $m$ edges and no isolated vertices. Recently this conjecture was proved by B. Sudakov. In this note, using the Sudakov's ideas we give an extension of his result and some interesting corollaries. (This is joint work with L. Maherani.)

**Speaker and Institution:** Daniel Pinto, CMUC, University of Coimbra, Portugal

**Title:** Duality on hypermaps with symmetric or alternating monodromy group

**Abstract:** A hypermap is, in its topological form, a cellular embedding of a connected hypergraph. Hypermaps can be modified by some operations, like duality (the operation that interchanges hypervertices and hyperfaces on oriented hypermaps). The notion of duality index was created to measure how far a hypermap is from being self-dual, and that notion plays an important role in this work.

We say that an oriented regular hypermap has duality-type $\{l, n\}$ if $l$ is the valency of its vertices and $n$ is the valency of its faces. We will present some properties of the duality index of oriented regular hypermaps and we will prove that for each pair $n, l \in \mathbf{N}$, with $n, l?2$ (but not both equal to 2), it is possible to find an oriented regular hypermap with extreme duality index (very distant from being self-dual) and of duality-type $\{l, n\}$, even if we are restricted to hypermaps with alternating or symmetric monodromy group.

**Speaker:** S. Pirzada, University of Kashmir

**Title:** Scores, losing scores and degrees in hypertournaments

**Abstract:** Hypertournaments are generalizations of tournaments. Given two non-negative integers $n$ and $k$ with $n \geq k > 1$, a $k$-hypertournament on $n$ vertices is a pair $(V, A)$, where $V$ is the set of vertices with $|V| = n$, and $A$ is the set of $k$-tuples of vertices, called arcs, such that for any $k$-subset $S$ of $V$, $A$ contains exactly one of the $k!$ $k$-tuples whose entries belong to $S$. The score $s(v_i)$ or $s_i$ of a vertex $v_i$ is the number of arcs containing $v_i$ in which $v_i$ is not the last element, and the losing score $r(v_i)$ or $r_i$ of a vertex $v_i$ is the number of arcs containing $v_i$ in which $v_i$ is the last element. The score sequence (losing score sequence) is formed by listing the scores (losing scores) in non-decreasing order. The total score $t_i$ of a vertex $v_i$ is defined as $t_i = s_i - r_i$. So $T = [t_i]_1^n$, called the total score sequence, is a non-increasing sequence of integers. We discuss the characterizations of score , losing score , total score and degree sequences in hypertournaments and bipartite hypertournaments. Finally we obtain various inequalities which give the bounds for scores, losing scores in hypertournaments.

**Speaker and Institution:** Alison Purdy, University of Regina, Canada

**Title:** A lower bound in the Erdős-Ko-Rado theorem for permutations

**Abstract:** The Erdős-Ko-Rado theorem is a fundamental result in extremal set theory that describes the size and structure of the largest collection of pairwise $t$-intersecting subsets of size $k$ from a set of size $n$. Similar results have been proved for $t$-cycle-intersecting and $t$-intersecting families of permutations provided that $n$ is sufficiently large relative to $t$. In this talk I will

discuss how techniques used by Ahlswede and Khachatrian in their proof of the Complete Erdős-Ko-Rado theorem can be adapted to give an exact lower bound on $n$ for $t$-cycle-intersecting and certain $t$-intersecting families of permutations.

**Speaker and Institution:** Sahar Qajar, Sharif University of Technology, Iran

**Title:** Some Results for the Roman domination number of graphs

**Abstract:** A labeling $f : V(G) \to \{0, 1, 2\}$ satisfying the condition that every vertex with label 0 has a neighbor with label 2, is a *Roman domination function* on a graph $G = (V(G), E(G))$ . A *Roman domination number* $\gamma_R(G)$ of $G$ is the minimum of $\sum_{v \in V(G)} f(v)$ over such functions. In this talk, we would like to provide some new sharp bounds for the Roman domination number in some families of graphs.

**Speaker and Institution:** Ghaffar Raeisi, Shahrekord University, Iran

**Title:** Loose path and loose cycle Ramsey numbers in hypergraphs

**Abstract:** For given $k$-uniform hypergraphs $\mathcal{H}_1, \mathcal{H}_2, \ldots, \mathcal{H}_t$, the *Ramsey number* $R(\mathcal{H}_1, \mathcal{H}_2, \ldots, \mathcal{H}_t)$ is the smallest integer $N$ such that in every $t$-coloring of the hyperedges of the complete $k$-uniform hypergraph $\mathcal{K}_N^k$ there is a monochromatic copy of $\mathcal{H}_i$ in color $i$, for some $i$, $1 \leq i \leq t$. The $k$-uniform *loose cycle* $\mathcal{C}_n^k$ (shortly, a *cycle of length* $n$), is the hypergraph with vertex set $\{v_1, v_2, \ldots, v_{n(k-1)}\}$ and with the set of $n$ edges $e_i = \{v_1, v_2, \ldots, v_k\} + i(k-1)$, $i = 0, 1, \ldots, n-1$, where we use mod $n$ arithmetic and adding a number $t$ to a set $H = \{v_1, v_2, \ldots, v_k\}$ means a shift, i.e. the set obtained by adding $t$ to subscripts of each element of $H$. Asymptotic values of hypergraph Ramsey numbers for loose cycles (and paths) were determined recently. Here we determine some of them exactly.

**Speaker and Institution:** Dimbinaina Ralaivaosaona, African Institute for Mathematical Sciences (AIMS), South Africa

**Title:** Number of summands in random partition

**Abstract:** In 1941, Erdős and Lehner provided limit theorems for the number of summands in random integer partition. Further generalizations and extensions of the Erdős-Lehner results have been given for different types of partitions in recent years, involving heavy analytic tools. In this talk, we intend to present various results concerning restricted partitions, these are partitions with certain restrictions.

**Speaker and Institution:** David Roberson, University of Waterloo, Canada

**Title:** Quantum Homomorphisms

**Abstract:** We say that a graph $X$ admits a quantum homomorphism to a graph $Y$ if two separated quantum players can convince a verifier with certainty that there exists a homomorphism from $X$ to $Y$. Interestingly, there exist graphs $X$ and $Y$ such that $X$ admits a quantum homomorphism to $Y$, but there is no (classical) homomorphism from $X$ to $Y$. The existence of a quantum homomorphism from $X$ to $Y$ turns out to be equivalent to the existence of an assignment of projectors to the elements of $V(X) \times V(Y)$ satisfying certain conditions. Quantum homomorphisms allow us to define quantum analogs of graph parameters that can be defined via homomorphisms. A specific example of this is the quantum chromatic number, which has received attention from both graph theory and quantum research communities. In this talk we will introduce quantum homomorphisms and discuss general facts concerning this concept, for example, it's relation to the Lovász theta number. Time permitting, we will give an example of a small graph with different chromatic and quantum chromatic numbers.

**Speaker and Institution:** Khashayar Sartipi, Sharif University of Technology, Iran

**Title:** On Zero-Sum Flows in Hypergraphs

**Abstract:** Let $G$ be a hypergraph with the incidence matrix $N$. We say that the hypergraph $G$ admits a zero-sum flow if there exists a nowhere-zero vector $u$ in the null space of $N$. Also we say that $G$ admits a $k$-sum flow if there exists a vector $u$ in the null space of $N$ with entries in the set $\{\pm 1, \ldots, \pm(k-1)\}$. We prove that for every hypergraph $G$ there exists a 3-regular 3-uniform hypergraph $G_0$ such that $G$ admits a zero-sum flow if and only if $G_0$ admits a zero-sum flow. Moreover, if $G_0$ admits a $k$-sum flow, then $G$ admits a $k$-sum flow as well.

**Speaker and Institution:** Behnam Shahbazi, Sharif University of Technology, Tehran, Iran.

*Title:* Some Kind of Graph Labelings

In this talk we study some kind of graph labelings. Let $c_1, \ldots, c_n \in \mathbf{Z}_k$. For a graph $G$, a $\mathbf{Z}_k$-*labeling* is a function $\omega : E(G) \longrightarrow \mathbf{Z}_k$, such that for each $i$, $1 \leq i \leq n(n = |V(G)|)$, $c_i = \sum_{v_i v_j \in E(G)} \omega(v_i v_j) \pmod{k}$. A graph $G$ is called $k$-*decent* if and only if there exists a $\mathbf{Z}_k$-labeling for every arbitrary $c_i$

assigned to its vertices. We show that for a given $c_1, \ldots, c_n \in \mathbf{Z}_k$, a bipartite graph has a $\mathbf{Z}_k$-labeling if and only if the sum of values assigned to the vertices of both parts are the same. We prove that for odd values of $k$, every non-bipartite connected graph is a $k$-decent graph. We also prove a similar result for even $k$ if and only if $\sum_{i=1}^{n} c_i$ is divisible by 2 in $\mathbf{Z}_k$. It is shown that for, $n \geq 4$, $k \geq 5$ ($k$ is odd), $K_n$ has a labeling ($E(G) \longrightarrow \mathbf{Z}_k \backslash \{0\}$), for any arbitrary $c_i \in \mathbf{Z}_k$ assigned to its vertices. Among other results, we show that if we assign two arbitrary $\{0, 1\}$-vertex labelings to the graph $G$ such that for every $v \in V(G)$, the sum of values of neighbours of $v$ is 1, then the number of 1 is constant in any such labelings.

**Speaker and Institution:** Hidehiro Shinohara, Tohoku University, Japan

**Title:** An infinite family of square Lehman matrices which are not cores of minimally non-ideal hypergraphs

**Abstract:** A hypergraph is said to be ideal if its associated set covering problem is solvable by Linear programming. Since the idealness of hypergraph is a hereditary property, it is characrized by minimal forbidden minors. It is well known that the incidence matrices of all minimally non-ideal hypergraphs contain so called “square Lehman matrices” as their row submatrices. Many researchers believe that most of the square Lehman matrices are not contained in the minimally non-ideal hypergraphs. However, only $PG(2, 3)$ is known as an example of such matrix. In this talk, we construct an infinite family of such square Lehman matrices.

**Speaker and Institution:** S Sivaramakrishnan, Indian Institute of Technology, India

**Title:** Signed excedance enumeration in $S_n$ and $B_n$

**Abstract:** Mantaci [1994] showed that enumerating signed excedance in the permutation group $S_n$ gives attractive results. Mantaci and Rakotondrajao [2003] showed a similar result when enumeration is done over the set of derangements of $S_n$.

We give a new proof of these results using determinants and also give some analogous results when enumeration is done in the hyperoctahedral group $B_n$. Some of our results generalise the original results of Mantaci and Mantaci & Rakotondrajao.

**Speaker and Institution:** Ali Taherkhani, Institute for Advanced Studies in Basic Sciences (Zanjan), Iran

**Title:** Graph Power and Circular Chromatic number

**Abstract:** In this talk we introduce graph power and explain some of its properties. We have shown that $\chi_c(G^{(2r+1)/(2s+1)}) = \frac{(2s+1)\chi_c(G)}{(s-r)\chi_c(G)+2r+1}$ provided that $\chi_c(G^{(2r+1)/(2s+1)}) < 4$, where $\chi_c(G)$ is the circular chromatic number of $G$. In particular, $\chi_c(K_{3n+1}^{1/3}) = \frac{9n+3}{3n+2}$ and $K_{3n+1}^{1/3}$ has no subgraph with circular chromatic number equal to $\frac{6n+1}{2n+1}$. This provides a negative answer to a question asked in [Xuding Zhu, Circular chromatic number: a survey, Discrete Math., 229(1-3):371–410, 2001]. (Joint work with Hossein Hajiabolhassan)

**Speaker and Institution:** Shoichi Tsuchiya, Tokyo University of Science, Japan

**Title:** Forbidden subgraphs and homeomorphically irreducible spanning trees

**Abstract:** A spanning tree with no vertices of degree two of a graph is called a *homeomorphically irreducible spanning tree* (or *HIST*) of the graph. Recently, we obtain some results about forbidden subgraphs and HIST as follows. connected graph $G$. In this talk, we characterize sets of forbidden subgraphs that imply the existence of a HIST in a connected graph of sufficiently large order. Moreover, we also focus on connected graphs that contain no path of order 4 (resp., 5) as an induced subgraph that is, we characterize $P_4$*-free graphs* (resp., $P_5$*-free graphs*) having a HIST.

**Speaker and Institution:** Le Anh Vinh, Vietnam National University - Hanoi, Vietnam

**Title:** Explicit construction of existentially closed graphs from geometries over finite fields

**Abstract:** Let $n, t$ be positive integers. A $t$-edge-colored graph $G$ is $(n, t)$-e.c. or $(n, t)$-existentially closed if for any $t$ disjoint sets of vertices $A_1, \ldots, A_t$ with $|A_1| + \ldots + |A_t| = n$, there is a vertex $x$ not in $A_1 \cup \ldots \cup A_t$ such that all edges from this vertex to the set $A_i$ are colored by the $i$-th color. In this talk, we will construct explicitly many $(3, t)$-e.c. graphs from geometries over finite fields.

**Speaker and Institution:** S. Yazdanbod, Sharif University of Technology, Iran

**Title:** On the Gallai coloring of complete $k$-partite graphs

**Abstract:** The Gallai coloring of a complete graph is defined to be an edge coloring such that no triangle is colored with three distinct colors. The Gallai coloring can be extended to any arbitrary graph. The Gallai coloring number of a graph $G$ is the maximum number $r$ such that $G$ has a Gallai coloring using $r$ colors. We denote the Gallai coloring of $G$ by $Gall(G)$. In this talk we prove that $Gall(K_{m,n,r}) = m + nr$ if $m \leq n \leq r$ and $Gall(K_{m,n,r,s}) = mn + rs + 1$ if $m \leq n \leq r \leq s$. We conjecture that:

$$Gall(K_{n_1,\ldots,n_k}) = \begin{cases} n_1n_2 + n_3n_4 + \ldots + n_{k-1}n_k + k' - 1 & \text{if } k = 2k' \\ n_1 + n_2n_3 + n_4n_5 + \ldots + n_{k-1}n_k + k' - 1 & \text{if } k = 2k' + 1 \end{cases}$$

where $n_1 \leq n_2 \leq \ldots \leq n_k$. (Joint work: A.M. Ahmadinejad, S. Akbari, S. Dehghani)