



## International Conference on Discrete Mathematics (ICDM-2019)

Hari Baskar\*

### Abstract

This is the report of the International Conference on Discrete Mathematics (ICDM-2019) held at CHRIST (Deemed to be University) during June 8-10, 2019 as part of the Academy of Discrete Mathematics and Applications (ADMA) annual conference and Graph Theory Day.

**Keywords:** ADMA, ICDM, CHRIST

The annual conference of the Academy of Discrete Mathematics and Applications (ADMA) was organized by the Department of Mathematics, CHRIST (Deemed to be University) during June 8-10, 2019 with the title International Conference on Discrete Mathematics (ICDM-2019).

### June 8, 2019- Day 1

The inaugural programme of the three day International Conference on Discrete Mathematics (ICDM-2019) started on 8th June 2019, at 9:45 a.m. The programme was presided by Dr. Fr. Abraham V.M, Vice Chancellor, CHRIST (Deemed to be University), Dr. George Thomas, Dean of Sciences, Dr. T.V. Joseph, Head, Department of Mathematics, Dr. G. Ravindra, President of Discrete Mathematics and Applications (ADMA), and Dr. Paradesi Tabitha Rajashekar, the Staff Coordinator of the Conference. The programme was initiated by invoking the blessings of the Almighty with the lighting of the lamp which was followed by the welcome speech. Dr. T. V. Joseph in his welcome speech has put forward the aims of the conference that were aimed at bringing the researchers and scholars together to share their ideas. He congratulated the ADMA team for their contributions to the conference. Following the welcome address, Dr. G Ravindra gave the

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\*Department of Mathematics, CHRIST (Deemed to be University); [hari.baskar@christuniversity.in](mailto:hari.baskar@christuniversity.in)



**Figure 1.** Participants in front of the Central Block, CHRIST (Deemed to be University). Front Row: Aparna Lakshmanan (Secretary, ADMA), Prof. Shamik Ghosh, Prof. S. K. Vaidya, Prof. G. Ravindra (President, ADMA), Dr. B. Soorya Naryana, Prof. S. Ramachandran, Prof. Mukti Acharya and Dr. Medha Itagi Huligol

presidential address and also welcomed all the dignitaries, delegates and young researchers. He honoured the works and achievements of Dr. E. Sampathkumar and also encouraged the participants to take part in the conferences as well as to be active in their research. Dr. Fr. Abraham V. M. in his inaugural speech, recalled the memories of the introducing the ambience of Research in Graph Theory at CHRIST (Deemed to be University). He remembered the various discussions under Dr. E Sampathkumar which gave many ideas to the researchers and encouraged the students to be “imaginatively proactive”, think differently and contribute to the field of Graph Theory. This was followed by the unveiling of the souvenir and the address of Dr. George Thomas, who very much appreciated the growth of the Graph Theory in the University and encouraged the organizers to continue with the passion forever. Dr. Paradesi Tabitha Rajashekar gave the vote of thanks where she thanked the team for their valuable efforts to make the conference happen.

### 1. B. D. Acharya Endowment Lecture

by Prof. S. M. Hegde, National Institute of Technology Surathkal, India.



**Figure 2.** Release of the Book of Abstracts. Dr. T. V. Joseph, Dr. George Thomas Chirayil, Dr. Fr. Abraham V. M., Dr. G. Ravindra and Dr. Paradesi Tabitha Rajashekar

### Topic: **Dr. Belmannu Devadas Acharya and Graph Labelings**

Time: 10.30 am - 11.30 am

The session was chaired by Dr. G. Ravindra. Being the first student of Dr. B.D. Acharya, Dr. S. M. Hegde emphasized the importance of “Guru” in life with a small poem on Dr. B. D. Acharya. He recalled the memories of his PhD days in Karnatak University and later at Mehta Institute, Allahabad. Dr. B. D. Acharya was an inspiration to him who encouraged him to continue his further studies in Graph Theory. Emphasis of his talk was on Graph Labelling and its applications, which was introduced in the mid sixties. The origin of Graph labelling stated by Ringel’s Conjecture was discussed along with various types of Graph labelling such as graceful labelling and sequential labelling. He also mentioned about the two conjectures on k-sequential graphs, which was a joint contribution of Dr B D Acharya and himself. The other topics discussed during the lecture were on Arithmetic Graphs, Indexable Graphs, Set Valuation of Graphs and Graceful Directed Graphs.

The session was concluded by question answer session which was later followed by handing over the memento to Dr. S. M. Hegde by Dr. G. Ravindra.

## 2. Invited talk 1: Semi graph, Properties and Applications

by Dr. Charusheela Deshpande, College of Engineering, Pune, India



**Figure 3:** Dr. G. Ravindra and Dr. S. M. Hegde

Time: 12.00 noon - 12.45 pm

The session was chaired by Dr. Mukti Acharya. Dr. Charusheela Deshpande obtained B.Sc degree by securing first class and bagged 8 gold medals and 3 cash prizes from Institute of Science, Nagpur. She has received her Ph.D from Pune University in Graph Theory and also the recipient of science award in distinguished women during VIVA 2019 by Venus International Foundation. First and foremost she thanked the Organizers expressed her gratitude towards Dr. E. Sampath Kumar, for introducing the concept of Semigraphs which encouraged her to do further research on Semigraphs and its Applications. She emphasised on the basic definitions of Semigraphs with an example and the degree associated with Semigraphs. She explained in detail about Adjacency matrix, Incidence Matrix and  $i$  - semi graphical matrix, with examples. The other topics discussed during the lecture were Algorithms to construct Semigraphs from a given semi graphical matrix, Eigenvalues of Semigraphs and Energy of Semigraphs. She along with her PhD scholars have contributed on Text Recognition using Semigraphs.

This session was concluded by question answer session which was later followed by handing over the memento to Dr. Charusheela Deshpande by Dr. Mukti Acharya.

### 3. F. Harary Endowment Lecture

by Dr. B.S. Dayasagar, Indian Statistical Institute, Bangalore, India.

Topic: **Mathematical Morphology (MM) & Applications: An Illustrative Overview (with some emphasis on MM via Graphs)**

Time: 02.00 am - 03.00 pm

The session was chaired by Dr. Charusheela Deshpande. Dr. B.S.



**Figure 4:** Dr. Charusheela Deshpande

Dayasagar, a full Professor of the Systems Science and Informatics Unit (SSIU) at the Indian Statistical Institute directed his talk on the mathematics to study the science of shapes which is known as Mathematical Morphology. The talk covered the applications of mathematical morphology in geoscience, satellite operations and in various other fields. Through the works of Frank Harary, the Father of Graph Theory, he introduced the concept of Mathematical Morphology. The lecture was to make people aware of a field that deals with several challenges encountered in spatial data science. He mentioned about the applications of Mathematical Morphology in Artificial Landscape and Flooding Transformation. Along with other topics he covered various aspects of Fractal Landscapes and some experimental results on a cluster of zones of water bodies. Moreover he gave an idea on how to apply the fundamental operations of Mathematical Morphology like erosion and dilation on graphs.



**Figure 5:** Dr. B.S. Dayasagar

As a token of appreciation, memento was handed over to Dr. B.S.

Dayasagar by Dr. Charusheela Deshpande.

#### 4. Contributory Session 1

Time: 03.00 pm - 04.45 pm

Presentations of the contributions were held in four venues and the details are as follows:

##### 4.1 Venue: K.E. Auditorium, Block 4

Chair: Angsuman Das

1. Paper Title: Dominating Safe Sets in Graphs  
Presented by: R. Sundareswaran
2. Paper title: Roman Vertex Covering Functions in Graphs  
Presented by: S.M Badiyani
3. Paper title: Vertex-Edge Neighbourhood Prime Labelling of Some Trees  
Presented by: A.K Rathod
4. Paper title: Radio Number of Level-Wise Regular Block Graphs  
Presented by: Devsi Bantva
5. Paper title: Cube Divisor Cordial Labelling in the Context of Join  
Presented by: B M Patel

##### 4.2 Venue : Room No.: 502, Block 4

Chair : Dr. Joseph Varghese

1. Paper title: A Note on Domination Cover Number On Different Graph Operations Presented by: P. Venkata Subba Reddy
2. Paper title: Connected Majority Domination Edge Critical Graphs Presented by: T Muthukani Vairavel
3. Paper title: Construction of L-Borderenergetic Graphs Presented by: Kalpesh M. Popat
4. Paper title: On Randić Energy of Graphs Presented by: Gopal K Rathod
5. Paper title: On 3-Regular Subgraphs of a Augmented Cube Presented by: Amruta Shinde
6. Paper title: Double Roman Domination in Join, Corona and Rooted Product of Graphs Presented by: P. Venkata Subba Reddy

#### 4.3 Venue : Room No.: 507, Block 4

Chair : Dr. Mathew Varkey

1. Paper title: Cordial Labelling For The Line Graph of Bistar  
Presented by: M I Bosmia
2. Paper title: Modified Cycle Frames of Complete Multipartite Multigraphs Presented by: S. Duraimurugan
3. Paper title: Graphs With Large General Position Number  
Presented by: Elias John Thomas
4. Paper title: 3 Successive C-Edge Coloring of Graphs  
Presented by: Aswathy U
5. Paper title: Induced Signed Graphs of Some Classes of Graphs  
Presented by: Achu Anivan

#### 4.4 Venue : Room No.: 501, Block 4

Chair : Dr. Aparna Lakshmanan

1. Paper title: Some Properties Of Eccentricity Splitting Graph of a Graph  
Presented by: Nivedha Baskar
2. Paper title: On Chromatic Transversal Domination in Graphs  
Presented by: Parmar Anil D
3. Paper title: On Restrained Edge Dominating Set of Graphs  
Presented by: Parag D Ajani
4. Paper title: Characteristic Polynomials of Some Algebraic Graphs  
Presented by: Manoharsinh R Jadeja
5. Paper title: On an Undirected Graph  $G_n$  on Finite Subset of Natural Numbers  
Presented by: Ivy Chakrabarty

### June 9, 2019- Day 2

#### 5. Contributory Session 2

Time: 08.30 am - 10.00 am

Presentations of the contributions were held in two venues and the details are as follows:

5.1 Venue : K.E. Auditorium, Block 4

Chair : Dr. Mathew Varkey

1. Paper title: Distributivity of different string operations over language sets  
Presented by: Ujwal Kumar Mishra
2. Paper title: l-Rauzy graphs  
Presented by: Rajavel Praveen
3. Paper title: The Effects of Overheating, Socioeconomic Status and Modern Practises: Structural Equation Modelling Approach to Childhood Obesity  
Presented by: Priyanka Victor
4. Paper title: Equitable Antimagic Difference Labelling of Graphs  
Presented by: Antony Puthussery
5. Paper title: Hamilton Waterloo Problem with C16-Factors and Cm-factors  
Presented by: L. Panneerselvam

5.2 Venue : Room No: 507, Block 4

Chair : P. Venkata Subba Reddy

1. Paper title:Geo chromatic number of cartesian product of some graphs  
Presented by: Divya B
2. Paper title: Domination essential edges in a graph: Edge contraction and deletion  
Presented by: Kiran S
3. Paper title: PBIB Designs arising from maximal independent sets of product graphs  
Presented by: Vidya M D
4. Paper title: Radio Graceful Labelling  
Presented by: Ramya
5. Paper title:Perfect Italian Domination number of graphs  
Presented by: Jismy Varghese

**6. Invited Talk 3: Oriented Bipartite Graph and The Goldbach Graph**

Prof. Shamik Ghosh, Jadavpur University, Kolkata, India

Time: 10.00 am - 10.45 am

The session was chaired by Dr. Sameer K. Vaidya. Dr. Shamik Ghosh took over the session by discussing the basic concepts of Directed Bipartite Graphs, Oriented Bipartite Graphs, Adjacency Matrix, Unidirectional Graphs, Bitransitive Graphs, Bitournament Graphs and demonstrating each concept with various examples. His talk mainly dealt with Oriented Bipartite Graphs, Odd-even Graphs and the Goldbach Graph. The talk was then directed to the Caccetta-Haggkvist Conjecture which was discussed and explained with the proof. He discussed on the concept of Bipartite Graph as an odd-even graph and topological ordering of vertices. The talk was concluded by giving a few observations on the Goldbach graphs and connectedness of graphs.



Figure 6: Dr. Shamik Ghosh

As a token of appreciation, the memento was handed over by Dr. Sameer K. Vaidya to Dr. Shamik Ghosh.

## 7. E. Sampathkumar Endowment Lecture

by Dr B Sooryanarayana, Dr. AIT, Bangalore.

Topic: **Alliances in Graphs** Time: 11.15 am - 12.15 pm

The session was chaired by Dr. S. Ramachandaran. By remembering the works and contributions of Dr. E. Sampathkumar, Dr. B Sooryanarayana started his lecture by introducing the concept of Alliances in Graphs. He mentioned the significance of attackers and defenders in Alliances and the importance of strong alliances in graphs. He discussed the motivation behind the concept of alliances in graphs and the practical situations, where these concepts are used. He illustrated Attackers Alliance and Defenders Alliance and established the relationship between them. He gave the bounds characterization of 1-Strong Alliances in Graphs and elaborated on Cluster Defensive Alliance. The session concluded by discussing some open problems

in Alliances which was followed by a question and answer session. As a token of appreciation, memento was handed over by Dr. S. Ramachandran to Dr. B. Sooryanarayana.



Figure 7: Dr. B Sooryanarayana

### 8. Invited Talk 3 on On Polycirculant Conjecture

by Dr. Angsuman Das, Presidency University, Kolkata, India.

Time: 12.15 am - 01.00 pm

The session was chaired by Dr. Shamik Ghosh. Dr. Angsuman Das took over the session by highlighting that “Polycirculant conjecture lies between the interface of graph theory and algebra” and also gave the idea of approach starting with graphs and to get some algebraic structures out of the graph. He mentioned basic concepts like non adjacency, k-regular, isomorphism, automorphism and quasi-abelian cayley graphs. He discussed on characterizing cayley graphs, vertex transitive graphs and a conjecture on vertex transitive graphs. His work mainly focused on Polycirculant Conjecture. Then he proved theorems on semi regular subgroup of automorphism of graph, followed by idea of groupifiable graphs and proofs on groupifiable graphs. He further explained equivalent form of polycirculant conjecture and Quasi-groupifiable graphs by giving a few observations on the relationship between various graph classes. The session concluded by discussing Right power associate quasi groupifiable graphs which was followed by a question and answer session.

As a token of appreciation, memento was handed over by Dr. Shamik Ghosh to Dr. Angsuman Das.

### 9. V. Swaminathan Endowment Lecture

by Prof. S. Ramachandran, Noorul Islam University, Nagercoil, Tamil Nadu, India.

Topic: **Forty years of degree-association in the reconstruction of graphs and digraphs**



**Figure 8:** Dr. Angsuman Das

Time: 02.15 am - 03.15 pm

The session was chaired by Prof. B Sooryanarayana. Prof. S. Ramachandran started the talk by explaining the basics of reconstruction, cards and decks. He explained Ulam’s graph reconstruction conjecture (UGC) and the history behind it. Another formulation of UGC using cards and decks was stated and along with that, two approaches for solving UGC were also explained. He listed out the families of graphs that are reconstructible and explained each one of them in detail. Reconstructible parameters such as number of vertices, number of edges, degree sequence and number of hamiltonian cycles were stated along with the proofs. Necessary and sufficient conditions for a graph to be reconstructible were discussed under the 3rd approach for solving UGC which is an extremely evolving topic. The talk also included digraph reconstructible conjecture (DRC) which was disproved after twelve years by a student of Prof. Harary. Further New Digraph Reconstruction conjecture were explained which resulted into DACARD and DADECK. The lecture was concluded by explaining the present situation of URC and Kocay’s theory of hypomorphisms and orbits.



**Figure 9:** Caption of the Diagram

As a token of appreciation, memento was handed over by Dr. B Sooryanarayana to Prof. S. Ramachandran.

## 10. Invited Talk 4 on Lucky k-polynomials of null graphs

by Dr. Johan Kok, Tshwane Metro Police Department, South Africa.

Time: 03.15 pm - 04.00 pm

Dr. Johan Kok was connected via SKYPE.



**Figure 10:** Dr. Johan Kok

He started the discussion by giving basic definitions of graph, null graph, colouring, chromatic number, chromatic complete graph etc.,. He emphasized on application of number theoretic results in area of chromatic complete graphs. He discussed on Lucky's theorem which was extensively used in the second part of his talk. The talk was carried forward to Lucky K-polynomial of Null graphs. Recursive results were discussed in order to find Lucky k-polynomial of Null graph for  $k=2, 3$  and then it was extended for other values of 'k'. He discussed the research problem of finding Lucky 2-polynomial and Lucky 3-polynomial of the path graphs with four vertices by finding Bell partitions using recursion. He insisted that if the solution was initiated by stirling partitions of the second kind, it would be more efficient. He concluded with an open problem to find the Lucky k-polynomial for a general graph.

## 11. Contributory Session 3

Time: 04.15 pm -05.30 pm

Presentations of the contributions were held in two venues and the details are as follows:

11.1 *Venue : Room No. 507, Block 4*

Chair : Dr. Charles Dominic

1. Paper Title: PBIB Designs emerging from minimum independent dominating sets of different jump size of Circulant Graphs  
Presented by: S. A. Diwakar

2. Paper Title: Some results on the  $\delta(k)$ -coloring of powers of Cycles, Paths and Generalized Petersen Graph  
Presented by: Merlin Thomas
  
3. Paper Title: Star Coloring of Cartesian Product of Paths and Cycles with Complete Bipartite Graphs  
Presented by: P. Hemalatha and S. N. Subhathra
  
4. Paper Title: The Vertex-Distance-Complement spectrum of subdivision-vertex join and subdivision-edge join of two regular graphs.  
Presented by: Ann Susa Thomas
  
5. Paper Title: Properties of the Formal Context Table of Boolean Algebra  
Presented by: Ramananda H S and Salma Shabnam

11.2 *Venue : Room No. 501, Block 4*

Chair : Dr. Medha Itagi Huilgol

1. Paper Title: On the Double Roman Domination Number of Generalized Sierpinski Graphs  
Presented by: Anu V.
  
2. Paper Title: Eccentric Domination Number of Some Path Related Graphs  
Presented by: Dhaval M. Vyas
  
3. Paper Title: The transformation graph  $G^{(+)}$  Presented by: Vidya Sadanand Raikar
  
4. Paper Title: On the pendant number of some graph products  
Presented by: Jomon K. Sebastian

### **Cultural Programme**

Time: 05. 30 pm 07:30 pm

## Conference Dinner

Time: 07:45 pm

### June 10, 2019- Day 3

#### 12. Contributory Session: 4

Time: 08.30 am - 10.00 am

#### 13. Venue : K. E. Auditorium, Block 4

Chair : Dr. Sudev N. K.

1. Paper Title: Laplacian Spectrum of Zero-Divisor Graph and Some Related Results  
Presented by: Saraswati Bajaj
2. Paper Title: A short journey with algebraic numbers  
Presented by: Anirban Roy

#### 14. P. Paulraja Endowment Lecture

by Prof. Mukti Acharya, Retired Professor, University of Delhi, New Delhi, India.

Topic: **Advances in Signed Graph Labelings.**

Time: 10.00 am - 11.00 am

The session was chaired by Dr.T.V Joseph. Prof. Mukti Acharya started the 5th endowment lecture by giving a brief description about signed and unsigned graphs. Vertex Equitable Signed Graphs, c-cordial signed graphs, Parity Signed Graphs. She explained about vertex equitable labelling, introduced by Sreenivasan and Lourdasamy and extended the notion of vertex equitable labelling to vertex equitable graphs and also some results on vertex equitable signed graphs. The talk included the idea of cordial labelling for signed graphs, canonical marking, total c-cordial, Parity Signed Graphs, “rna” number and “adhika” number She concluded her talk with the characterisation of Parity Signed Graphs and characterisation of Balanced Signed Graphs along with a few observations. The session was followed by a question and answer session.

As a token of appreciation, memento was handed over by Dr. T.V Joseph to Prof. Mukti Acharya .



**Figure 11:** Prof. Mukti Acharya

### **15. Invited Talk 5 on Graph Theory - An Emerging Field of Research**

by Dr. Samir K. Vaidya, Department of Mathematics, Saurashtra University, Gujarat.

Time: 11.15 am - 12.00 noon

The session was chaired by Prof. Mukti Acharya. Prof. S. K. Vaidya started the lecture by giving a historical background of Konig Problem and the theory of trees and also, the historical background of graph coloring. The preliminaries included coloring,  $k$ -coloring, chromatic numbers, edge coloring, graph labelling and graceful labelling which was introduced by Rosa and Golomb. He illustrated Ringel's conjecture and Kotzig's conjecture. The talk also included harmonious labelling in case of trees and few results on harmonious graph. He discussed domination sets with its historical background which took its origin in the game of chess. He discussed the application of domination in Defence, Radio and TV network.

As a token of appreciation, memento was handed over by Prof. Mukti Acharya to Prof. S. K. Vaidya.

### **16. Invited Talk 6 on On the geometric realisation of equal tempered Music**

by Dr. Robert Linton Tavis Ashton-Bell, Monash University in Melbourne, Australia.



Figure 12: Prof. S. K. Vaidya

Time: 12.00 noon - 01.00 pm

The session was chaired by Dr. G Ravindra. Dr. Robert began the session by mentioning about the research methodology and explained the terms hermeneutical phenomenology, mathematical symbolism and musical analysis methodology. He described on how tonal harmony relates Mathematics and music. In equal temperament versus just intonation that he included differ in their treatment of picture where temporal structures are common to both. He also added how music theorists use mathematics to visualise musical structures. He also pointed out that certain ideas on mathematics can be used to represent the structure that composers use to scaffold musical contexts. He also discussed the pitch considerations, pedagogical constraints, the equal tempered semitone, pitches with octave equivalence and matrix representation of angles around a unit circle, points on waveforms, frequencies and wavelength and intonation.



Figure 13: Dr. Robert Linton Tavis Ashton-Bell

As a token of appreciation, Dr. G Ravindra handed over the memento to Dr. Robert.

## 17. Graph theory Day - Felicitations

The Valedictory programme of the International Conference On Discrete Mathematics (ICDM-2019) started at 2:30 p.m. The programme was presided over by Dr Mahadeva Nayaka, Special Officer, Mandya University, Dr. S. Pranesh, Coordinator and Director of P.G. Programmes, Dr. G. Ravindra, President of Discrete Mathematics and Applications (ADMA), and Dr. N. K. Sudev, Organizing Secretary. The programme was started by invoking the blessings of the Almighty with an invocation song which was followed by the welcome speech by Dr. Sangeetha Shathish. The report on the ICDM-2019 was presented by Dr. Charles Dominic, Following this Dr. Mahadeva Nayaka addressed the gathering in which he remembered his days with Dr. E. Sampathkumar, Dr. B.D. Acharya and Dr. G.Ravindra and their contributions to Graph Theory, applications of Graph Theory.



Figure 14: All participants on the stage after the valedictory

Dr. G. Ravindra felicitated the of the research scholars who received their PhD degree during 2018-19. Dr. G. Ravindra also addressed the gathering in which he thanked the organising committee of ADMA-2019 and congratulated all the presenters in the contributory sessions. This was followed by address of Dr. S. Pranesh, where

he encouraged the youngsters to utilize the opportunities like conferences and congratulated the organizing committee. Following this was the feedback session in which, few delegates came forward and congratulated the organizing committee and thanked the speakers for making the conference a wonderful and memorable one. The Vote of Thanks was given by Dr. N. K Sudev where he thanked the entire organizing committee for their relentless efforts in making this conference a successful one.

### **Acknowledgments**

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