

Indian Women and Mathematics (IWM)

Annual Conference 2019

Conference Report

Department of Mathematics

Indian Institute of Technology Bombay

June 10 - 12, 2019

Summary

The IWM Annual Conference 2019 was held at the Indian Institute of Technology Bombay, Powai, Mumbai, India, from 10th June to 12th June of 2019.

The following people were involved in organizing this conference.

Advisory Committee:

Mahan MJ, TIFR

Mythily RAMASWAMY, TIFR CAM

Nalini JOSHI, University of Sydney

Sujatha RAMDORAI,

University of British Columbia

Executive Committee:

Amber HABIB, Shiv Nadar University

Anita NAOLEKAR, ISI Bangalore

Anisa CHORWADWALA, IISER Pune

B. Sri PADMAVATI, University of Hyderabad

Gautam BHARALI, IISc

Geetha VENKATARAMAN, Ambedkar University

Mahuya DATTA, ISI Kolkata

Neela NATARAJ, IIT Bombay (Chairperson)

Nikita AGARWAL, IISER Bhopal

Pooja SINGLA, IISc

Riddhi SHAH, JNU

Sachi SRIVASTAVA, University of Delhi

Shreemayee BORA, IIT Guwahati

Vijaylaxmi TRIVEDI, TIFR

Scientific Committee:

Sudhir GHORPADE, IIT Bombay

Neela NATARAJ, IIT Bombay

Mythily RAMASWAMY, TIFR CAM

Riddhi SHAH, JNU

Vijaylaxmi TRIVEDI, TIFR

Organizing Committee:

Mayukh MUKHERJEE, IIT Bombay

Siuli MUKHOPADHYAY, IIT Bombay

Neela NATARAJ, IIT Bombay

Rekha SANTHANAM, IIT Bombay

Vijaylaxmi TRIVEDI, IIT Bombay

Volunteers:

Anil BAGUL, IIT Bombay

Wasim AKRAM, IIT Bombay

Ruma Rani MAITY, IIT Bombay

Savita PAREEK, IIT Bombay

Vivek TEWARI, IIT Bombay

S. VENKATESH, IIT Bombay


There were 234 applications for participation in the conference, of which 51 candidates (45 female and 6 male) were selected. In addition to these, there were 13 invited speakers at the conference. So there were 64 registered attendees (who were given a registration kit) in the conference. Among the 51 selected attendees, 36 gave paper presentations, 4 gave poster presentations and 11 participated. Overall, there were 3 international attendees (2 from Nepal and 1 from Bangladesh) who were sponsored by IMU CWM, and 61 Indian attendees. In addition, there were also 16 local attendees from Mumbai and IIT Bombay who had not registered but attended several sessions. So there were a total of 80 attendees in the conference, registered and unregistered combined. Participation certificates were provided to the attendees of the conference.

A website was created for publishing the conference details online. The website link is <https://sites.google.com/view/iwm2019/>

A meeting of the Executive Committee was conducted on June 9, 2019 in the Conference Room, Vanvihar Guest House.

The Chief Guest for the inaugural session was Prof. Subhasis Chaudhuri, Director, IIT Bombay. The session comprised of a welcome by Prof. Siuli Mukhopadhyay, and was followed by addresses by Prof. Neela Nataraj, Chair, IWM Executive Committee and Convenor of the Annual Conference 2019, and Prof. Suresh Kumar, Head, Department of Mathematics, and the Chief Guest. This was followed by the scientific programme of the conference.

The conference mainly comprised of 3 plenary talks, 4 invited talks, 5 talks by young mathematicians, 1 mini course comprising of 3 lectures, 36 paper presentations and 4 poster presentations. The plenary talks, invited talks, talks by young mathematicians and the mini course were organized for all to



attend, and the paper presentation talks were organized via three parallel sessions on all three days of the conference. The poster presentations followed the parallel sessions on the first two days.

In addition to the sessions mentioned above, the third day of the conference also had 2 parallel interactive sessions, one each for the subject groups (a) analysis, differential equations, optimization, and (b) algebra, number theory, geometry and graph theory.

The scientific programme concluded with a vote of thanks by the Convenor, Prof. Neela Nataraj. This was followed by the Conference Dinner at the VMCC Hall.

The feedback from the attendees was overwhelmingly positive on the aspects of organization of the conference, mathematical content discussed and the utility of the conference to the attendees. The attendees unanimously expressed interest in being a part of more conferences of this kind.

Details of Invited Attendees

| Sr. No. | Name | Designation and Affiliation | Category |
|---------|-----------------------------|--|------------------------|
| 1. | Mahuya Datta | Professor, ISI Kolkata | Plenary Speaker |
| 2. | Mythily Ramaswamy | Professor, TIFR CAM | Plenary Speaker |
| 3. | Punita Batra | Professor H, Harish-Chandra Research Institute | Plenary Speaker |
| 4. | Clare D'Cruz | Associate Professor, Chennai Mathematical Institute | Invited Speaker |
| 5. | Meena Sahai | Professor, Lucknow University | Invited Speaker |
| 6. | Nandini Nilakantan | Professor, IIT Kanpur | Invited Speaker |
| 7. | Poornapushkala Narayanan | Postdoctoral Fellow, TIFR Mumbai | Invited Speaker |
| 8. | Eknath Ghate | Professor, TIFR Mumbai | Mini Course |
| 9. | Akshaa Vatwani | Assistant Professor, IIT Gandhinagar | Young Mathematician |
| 10. | Kamana Porwal | Assistant Professor, IIT Delhi | Young Mathematician |

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| 11. | Monika Bhattacharjee | Assistant Professor, IIT Bombay | Young Mathematician |
| 12. | Sasmita Barik | Associate Professor, IIT Bhubaneswar | Young Mathematician |
| 13. | Soma Maity | Assistant Professor, IISER Mohali | Young Mathematician |

Details of Selected Attendees

| Sr. No. | Name | Designation and Affiliation | Category |
|---------|-----------------------|--|--------------------|
| 1. | Anju Sood | Associate Professor, Sant Baba Bhag Singh University | Paper Presentation |
| 2. | Ajender Kumar Malik | Associate Professor, B K Birla Institute of Engineering And Technology Pilani | Paper Presentation |
| 3. | Neha Gupta | Assistant Professor, Shiv Nadar University | Paper Presentation |
| 4. | P. Lalitha | Assistant Professor, SRM University | Paper Presentation |
| 5. | Manjusha Kulshrestha | Professor, Anand Agricultural University | Paper Presentation |
| 6. | Salma Parvin | Professor, Bangladesh University of Engineering And Technology | Paper Presentation |
| 7. | Dipali Vasudev Mestry | MSc Student, Institute of Chemical Technology | Paper Presentation |
| 8. | Shalini M Patil | Assistant Professor, JSS Academy of Technical Education | Paper Presentation |

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| 9. | Aradhana Santosh Bandekar | Research Scholar, Goa University | Paper Presentation |
| 10. | Pratibha Verma | Research Scholar, MNNIT Allahabad | Paper Presentation |
| 11. | Achu Aniyam | MPhil Scholar, HRIST (Deemed to be University) | Paper Presentation |
| 12. | Sarika | Assistant Professor, Bennett University | Paper Presentation |
| 13. | Tuhina Mukherjee | Postdoctoral Fellow, TIFR CAM | Paper Presentation |
| 14. | Himanshu Rathore | Assistant Professor, Manipal University | Paper Presentation |
| 15. | Charu Goel | Assistant Professor, IIIT Nagpur | Paper Presentation |
| 16. | Yogesh Dadhich | Research Scholar, Manipal University | Paper Presentation |
| 17. | Madhavi Rao | Research Assistant, Indian Institute of Science | Paper Presentation |
| 18. | Acushla Sarswat | Research Scholar, Jawaharlal Nehru University | Paper Presentation |
| 19. | Asrifa Sultana | Assistant Professor, IIT Bhilai | Paper Presentation |
| 20. | Ashlesha A Bhise | Research Scholar, Visvesvaraya National Institute of Technology | Paper Presentation |

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| 21. | Anuwedita Singh | Research Scholar, IIT (BHU) | Paper Presentation |
| 22. | Manushi Gupta | Research Scholar, IIT (BHU) | Paper Presentation |
| 23. | Rajeshwari S. | Assistant Professor, Presidency University | Paper Presentation |
| 24. | Gauri Bhujju | Research Scholar, Kathmandu University | Paper Presentation |
| 25. | Prajapati Manojkumar Bhagubhai | Research Scholar, Jawaharlal Nehru University | Paper Presentation |
| 26. | Kabita Luitel | Research Scholar, Tribhuvan University | Paper Presentation |
| 27. | Priyanka Pandey | Research Scholar, CHRIST (Deemed to be University) | Paper Presentation |
| 28. | Deepshikha Chatterjee | Mphil Scholar, Ambedkar University | Paper Presentation |
| 29. | Husna V. | Assistant Professor, Presidency University | Paper Presentation |
| 30. | Rajdip Palit | Research Scholar, Jawaharlal Nehru University | Paper Presentation |
| 31. | Ruma Rani Maity | Research Scholar, IIT Bombay | Paper Presentation |
| 32. | A. Tanuja | Assistant Professor, Siddaganga Institute of Technology | Paper Presentation |

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| 33. | Sonika Dhillon | Research Scholar, IIT Ropar | Paper Presentation |
| 34. | Makeshwari M. | Research Scholar, Central University of Tamil Nadu | Paper Presentation |
| 35. | Nagendramma V. | Assistant Professor, Presidency University | Paper Presentation |
| 36. | Kavitha Sivasubramanian | Assistant Professor, SDNB Vaishnav College for Women | Paper Presentation |
| 37. | Reema Jain | Associate Professor, Manipal University | Poster Presentation |
| 38. | Radhika Vasisht | Research Scholar, University of Delhi | Poster Presentation |
| 39. | Bhawna Malik | Research Scholar, Shiv Nadar University | Poster Presentation |
| 40. | Barnali Saha | Assistant Professor, Vivekanand Education Society's Institute of Technology | Poster Presentation |
| 41. | Rajeswari Seshadri | Professor, Pondicherry University | Participant |
| 42. | Shuchita Goyal | Research Associate, IIT Bombay | Participant |
| 43. | Nidhish Unnikrishnan | Assistant Professor, | Participant |

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| | | Govt. Arts and Science College Thrithala | |
| 44. | Radha Ramchandra Sonavadekar | MSc Student, Institute of Chemical Technology | Participant |
| 45. | Shweta Ramesh | MSc Student, Institute of Chemical Technology | Participant |
| 46. | Mani Harshita Madduri | Research Scholar, Visvesvarayya National Institute of Technology | Participant |
| 47. | Gurusamy Arumugam | Research Associate, IIT Gandhinagar | Participant |
| 48. | Sangeetha B N | Research Scholar, M S Ramaiah University of Applied Sciences | Participant |
| 49. | Sarita | Research Sscholar, BITS Pilani | Participant |
| 50. | Palak Goel | Research Scholar, Shiv Nadar University | Participant |
| 51. | Keerthi Reddy N. | Assistant Professor, Presidency University | Participant |

Details of Talks

| Sr. No. | Speaker | Talk |
|---------|--------------------------|---|
| 1. | Mythily Ramaswamy | Beyond Parseval's identity (Plenary Talk) |
| 2. | Punita Batra | Integrable modules for full toroidal Lie algebras (Plenary Talk) |
| 3. | Mahuya Datta | Bracket generating distributions and the space of horizontal curves (Plenary Talk) |
| 4. | Clare D'Cruz | Monomial curves and invariants associated to them (Invited Talk) |
| 5. | Meena Sahai | Lie nilpotent group algebras (Invited Talk) |
| 6. | Nandini Nilakantan | The Kneser conjecture and Hom complexes (Invited Talk) |
| 7. | Poornapushkala Narayanan | Stability of Lazarsfeld-Mukai bundles (Invited Talk) |
| 8. | Eknath Ghate | Modular forms and Galois representations (Mini Course, 3 Lectures) |
| 9. | Monika Bhattacharjee | Asymptotics of large autocovariance matrices (Young Mathematician) |
| 10. | Sasmita Barik | Graphs with reciprocal eigenvalue property (Young Mathematician) |

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| 11. | Soma Maity | Stability of quadratic curvature functionals at product of Einstein manifolds (Young Mathematician) |
| 12. | Akshaa Vatwani | Variants of equidistribution in arithmetic progression (Young Mathematician) |
| 13. | Kamana Porwal | A finite element method for elliptic distributed optimal control problems with pointwise control and state constraints (Young Mathematician) |
| 14. | Anju Sood | Review on evolution of fractional order differential equations and their solutions |
| 15. | Ajender Kumar Malik | Importance of inventory control and management |
| 16. | Neha Gupta | A remark on extension of a monoidal structure |
| 17. | P. Lalitha | Application of graceful labeling techniques in hexagonal snakes along a path |
| 18. | Manjusha Kulshrestha | Prediction of monthly rainfall by artificial neural networks |
| 19. | Salma Parvin | Mathematical modeling and numerical simulation of blood flow through a stenosed artery in presence of external oriented magnetic field |
| 20. | Dipali Vasudev Mestry | Estimation of parameters of population dynamic models using Gibbs sampling |
| 21. | Shalini M Patil | Numerical approach to study the characteristics of porous journal bearings |

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| | | using couple-stress field |
| 22. | Aradhana Santosh Bandekar | On existence of solution of first order problems with nonlinear boundary conditions |
| 23. | Pratibha Verma | Comparative study of Adomian decomposition method for solving differential equations in ordinary and partial differential equations of fractional order |
| 24. | Achu Aniyar | Induced sign graphs of some classes of graphs |
| 25. | Sarika | Elliptic partial differential equations involving polynomial/exponential type nonlinearities with sign changing weight functions |
| 26. | Tuhina Mukherjee | n-Kirchoff equations involving Choquard type exponential nonlinearity |
| 27. | Himanshu Rathore | Two-warehouse inventory model with quantity discount policy |
| 28. | Charu Goel | A tale of two cones since Hilbert's 1888 theorem |
| 29. | Yogesh Dadhich | Study of non-Newtonian fluid models and their applications |
| 30. | Madhavi Rao | Analytical solution of Dirichlet problem involving Laplace's equation for various closed smooth curves |
| 31. | Acushla Sarswat | On the Dirichlet-Neumann first eigenvalue of a family of polygonal domains |
| 32. | Asrifa Sultana | Solutions for quasi-variational inequalities |

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| | | with unbounded constraint map |
| 33. | Ashlesha A Bhise | Discontinuity locator for hybrid weighted essentially non-oscillatory nonlinearity |
| 34. | Anuwedita Singh | Semi-infinite moving crack in an orthotropic strip sandwiched between two identical half-planes |
| 35. | Manushi Gupta | On representation of solutions for the theory of generalized thermoelasticity under modified Green-Lindsay model |
| 36. | Rajeshwari S. | Uniqueness of complex meromorphic function sharing a small function |
| 37. | Gauri Bhujju | Fuzzy dynamical system in SEIR epidemic model |
| 38. | Prajapati Manojkumar Bhagubhai | Expansivity of the action of an automorphism of G on $\text{Sub}(G)$ |
| 39. | Kabita Luitel | Finite difference approach to study the heat transfer in human body through clothes |
| 40. | Deepshikha Chatterjee | Cube free groups with GAP applications |
| 41. | Husna V. | Uniqueness of polynomial and differential monomial |
| 42. | Rajdip Palit | Distal action of automorphisms of a lattice G on $\text{Sub}(G)$ |
| 43. | Ruma Rani Maity | Discontinuous Galerkin finite element methods for the Landau-de Gennes minimization problem of liquid crystals |
| 44. | A. Tanuja | Some results on system of q -shift |

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| | | complex differential-difference equations |
| 45. | Sonika Dhillon | Linear independence of harmonic numbers |
| 46. | Makeshwari M. | A note on primitive roots of p^l , for all l at least 1 |
| 47. | Nagendramma V. | Transpiration on chemically reacting MHD thixotropic fluid flow due to penetrable stretching cylinder with nanoparticles with thermal radiation |
| 48. | Kavitha Sivasubramanian | Region of variability for a class of univalent functions |
| 49. | Priyanka Pandey | Graph Theory |



Poster of Conference



**National
Board for
Higher
Mathematics**
www.nbhm.dae.gov.in



Committee for
Women in Mathematics

Indian Women and Mathematics Annual Conference 2019

Venue : Lecture Complex Hall LH 101

10th - 12th June 2019



**Indian Institute of Technology Bombay
Department of Mathematics
Mumbai, India**



Schedule of Conference

Day 1: Monday, 10th June 2019

Inauguration: 9:00- 9.30 AM

Chief Guest: Prof. Subhasis Chaudhuri, Director, IIT Bombay

Venue: LH101

Session 1 Venue : LH 101

| Time | Speaker | Title | Chairperson |
|---------------------|-------------------|---|---------------|
| 9.30 AM – 10.20 AM | Mythily Ramaswamy | Beyond Parseval's identity | Neela Nataraj |
| 10.25 AM - 11.00 AM | Clare D'Cruz | Monomial Curves and invariants associated to them | Punita Batra |

11:00 AM – 11:30 AM Tea Break

Session 2 Venue: LH 101

| Time | Speaker | Title | Chairperson |
|---------------------|--------------|--|--------------------|
| 11.30 AM – 12.25 PM | Eknath Ghate | Modular Forms and Galois Representations (Mini course –Lecture 1) | Vijaylaxmi Trivedi |
| 12.30 PM - 01.05 PM | Soma Maity | Stability of quadratic curvature functionals at product of Einstein manifolds | Mahuya Dutta |

01:05 PM – 02:00 PM Lunch Break

Session 3

| Time | Parallel Session 1 Venue: LH-101 Chairperson: B. Sri Padmavati | Parallel Session 2 Venue : LT-101 Chairperson: Siuli Mukhopadhyay | Parallel Session 3 Venue: LT-102 Chairperson: Akshaa Vatwani |
|---------------------|---|--|--|
| 02.00 PM - 02.20 PM | Salma Parvin Mathematical modelling and numerical simulation of blood flow through a stenosed artery in presence of external oriented magnetic field | | |
| 02.20 PM - 02.40 PM | Shalini M Patil Numerical approach to study the characteristics of Porous Journal bearings using couple-stress fluid | Manjusha Kulshrestha Prediction of Monthly Rainfall By Artificial Neural Networks | Sonika Dhillon Linear independence of harmonic numbers |
| 02.40 PM - 03.00 PM | Manushi Gupta On representation of solutions for the theory of generalized thermo elasticity under modified Green-Lindsay model | Dipali Vasudev Mestry Estimation of Parameters of Population Dynamic models using Gibbs Sampling | Makeshwari M A note on primitive roots of p^{ℓ} for all $\ell \geq 1$ |
| 03.00 PM - 03.20 PM | Nagendramma V Transpiration on chemically reacting MHD Thixotropic fluid flow due to penetrable stretching cylinder with nanoparticles with thermal radiation | Himanshu Rathore Two-warehouse inventory model with quantity discount policy | |

03.20 PM – 04:00 PM Tea and Poster

Session 4 Venue: LH-101

| Time | Speaker | Title | Chairperson |
|---------------------|-----------------------------|---|---------------------|
| 04.00 PM – 04.35 PM | Monika Bhattacharjee | Asymptotics of Large Autocovariance Matrices | Kalyan Das |
| 04:40 PM - 05:15 PM | Sasmita Barik | Graphs with reciprocal eigenvalue property | Nutan Limaye |

Day 2: Tuesday, 11th June 2019

Session 1 Venue : LH-101

| Time | Speaker | Title | Chairperson |
|---------------------|---------------------------|---|-------------------------|
| 9.30 AM – 10.20 AM | Punita Batra | Integrable modules for full toroidal Lie algebras. | Ravi Raghunathan |
| 10.25 AM - 11.00 AM | Nandini Nilakantan | The Kneser Conjecture and Hom Complexes | Rekha Santhanam |

11:00 AM – 11:30 AM Tea Break

Session 2 Venue : LH-101

| Time | Speaker | Title | Chairperson |
|---------------------|---------------------------------|---|----------------------------|
| 11.30 AM – 12.25 PM | Ek Nath Ghat e | Modular Forms and Galois Representations (Mini course –Lecture 2) | Vijaylaxmi Trivedi |
| 12.30 PM - 01.05 PM | Poornapushkala Narayanan | Stability of Lazarsfeld-Mukai bundles | Sudarshan R. Gurjar |

01:05 PM – 02:00 PM Lunch Break

Session 3

| Time | Parallel Session 1 Venue : LH-101 Chairperson: S. Baskar | Parallel Session 2 Venue: LT-101 Chairperson: Shreemayee Bora | Parallel Session 3 Venue: LT-102 Chairperson: Vijaylaxmi Trivedi |
|---------------------|---|---|--|
| 02.00 PM - 02.20 PM | Anju Sood Review on Evolution of Fractional Order Differential Equations and their Solutions | Ajender Kumar Malik Importance of Inventory Control and Management | Neha Gupta A remark on extension of a monoidal structure |
| 02.20 PM - 02.40 PM | Aradhana Santhosh Bandekar On existence of solution of first order problems with nonlinear boundary conditions | Asrifa Sultana Solutions for Quasi-Variational Inequalities with unbounded constraint map | Acushla Sarswat On the Dirichlet-Neumann First Eigenvalue of a Family of Polygonal Domains |
| 02.40 PM - 03.00 PM | Prathibha Verma Comparative study of Adomian decomposition method for solving differential equations in ordinary and partial differential equations of fractional order | Priyanka Pandey Graph Theory | Prajapati Manojkumar Bhagubhai Expansivity of the action of an automorphism of G on Sub_G |
| 03.00 PM - 03.20 PM | Madhavi Rao Analytical Solution of Dirichlet problem involving Laplace's equation for various closed smooth curves | Anuwedita Singh Semi-infinite moving crack in an orthotropic strip sandwiched between two identical half planes | Rajdip Palit Distal action of automorphisms of a lattice G on $\mathrm{Sub}(G)$ |

03.20 PM – 04:00 PM Tea and Poster

Session 4 Venue : LH-101

| Time | Speaker | Title | Chairperson |
|---------------------|---------------------|---|---------------------------|
| 04.00 PM – 05.00 PM | Eknath Ghate | Modular Forms and Galois Representations (Mini course –Lecture 3) | Vijaylaxmi Trivedi |

05.15 PM – 07:00 PM **Interactive Session**

07.00 PM – 10:00 PM **Conference Dinner in VMCC Foyer**

Day 3: Wednesday, 12th June 2019

Session 1 **Venue : LH 101**

| Time | Speaker | Title | Chairperson |
|---------------------|---------------------|--|------------------------|
| 9.30 AM – 10.20 AM | Mahuya Datta | Bracket generating distributions and the space of horizontal curves | Rekha Santhanam |
| 10.25 AM - 11.00 AM | Meena Sahai | Lie Nilpotent Group Algebras | Clare D'Cruz |

11:00 AM – 11:30 AM **Tea Break**

Session 2

| Time | Venue: LT-101 Chairperson: Murali Srinivasan |
|---------------------|---|
| 11.30 AM - 11.50AM | Achu Aniyar Induced Signed Graphs of Some Classes of Graphs |
| 11.55 AM – 12.15 PM | P. Lalitha Application of Graceful Labeling techniques in Hexagonal Snakes along a Path |

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| 12.20 PM – 12.40 PM | Charu Goel A tale of two cones since Hilbert's 1888 theorem |
| 12.45 PM – 01.05 PM | Deepshikha Chatterjee Cube-free groups with GAP applications |

01:05 PM – 02:00 PM Lunch Break

Session 3

| Time | Parallel Session 1 Venue: LH-101 Chairperson: Sivaji Ganesh Sista | Parallel Session 2 Venue : LT-101 Chairperson: Anisa Chorwadwala | Parallel Session 3 Venue: LT-102 Chairperson: Prachi Mahajan |
|-------------------|---|--|---|
| 2.00 PM – 2.20 PM | Sarika Elliptic Partial Differential Equations involving polynomial/Exponential type nonlinearities with sign changing weight functions | Yogesh Dadhich Study of Non Newtonian fluid models and their application | Rajeshwari S. Uniqueness of Complex Meromorphic function sharing a small function |
| 2.20 PM – 2.40PM | Tuhina Mukherjee n-Kirchhoff equations involving Choquard type exponential nonlinearity | | Husna V. Uniqueness of polynomial and differential monomial |
| 2.40 PM- 3.00 PM | Ashlesha A Bhise Discontinuity Locator for hybrid Weighted Essentially Non-oscillatory Schemes | Gauri Bhujju Fuzzy Dynamical System in SEIR epidemic Modal | A. Tanuja Some results on system of q-shift complex differential-difference equations |

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|-------------------|---|--|---|
| 3.00 PM – 3.20 PM | <p style="text-align: center;">Ruma Rani Maity</p> <p style="text-align: center;">Discontinuous Galerkin Finite Element Methods for the Landau-de Gennes Minimization Problem of Liquid Crystals</p> | <p style="text-align: center;">Kabita Luitel</p> <p style="text-align: center;">Finite Difference Approach to Study the Heat Transfer in Human Body through Clothes</p> | <p style="text-align: center;">Kavitha Sivasubramanian</p> <p style="text-align: center;">Region of Variability for a class of univalent functions</p> |
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03.20 PM – 04:00 PM Tea

Session 4 Venue: LH-101

| Time | Speaker | Title | Chairperson |
|---------------------|-----------------------|---|-----------------------------|
| 04.00 PM – 04.35 PM | Akshaa Vatwani | Variants of equidistribution in arithmetic progression | U.K. Anandavardhanan |
| 4.40 PM – 5.15 PM | Kamana Porwal | A Finite Element Method for Elliptic Distributed Optimal Control Problems with Pointwise Control and State Constraints | Neela Nataraj |

5.15 PM – 5.30 PM Feedback & Valedictory Function

5.30 PM Farewell Tea



Book of Abstracts

Invited Speakers

Graphs with reciprocal eigenvalue property

Sasmita Barik

Indian Institute of Technology Bhubaneswar

Let G be a simple connected graph and $A(G)$ be the adjacency matrix of G . G is said to have the reciprocal eigenvalue property (property (R)) if $A(G)$ is nonsingular and the reciprocal of each of its eigenvalues is also an eigenvalue. Further, if the multiplicity of an eigenvalue equals that of its reciprocal, the graph is said to have property (SR) . In this talk, the classes of graphs with property (R) will be presented. Further, few interesting properties of such graphs will be discussed

Integrable modules for full toroidal Lie algebras

Punita Batra

Harish-Chandra Research Institute, Allahabad

Full toroidal Lie algebras are extensions of multiloop algebras twisted by several finite order automorphisms. I will try to classify irreducible integrable modules for these Lie algebras.

Asymptotics of large autocovariance matrices

Monika Bhattacharjee

Indian Institute of Technology Bombay

We consider high-dimensional moving average process and explore the asymptotics for eigenvalues of its sample autocovariance matrices. Under quite weak conditions, we prove, in a unified way, that the limiting spectral distribution (LSD) of any symmetric polynomial in the sample autocovariance matrices, after suitable centering and scaling, exists and is non-degenerate. We use methods from free probability in conjunction with the method of moments to establish our results. In addition, we are able to provide a general description for the limits in terms of some freely independent variables. We also establish asymptotic normality results for the traces of these matrices. We suggest statistical uses of these results in problems such as order determination of high-dimensional MA and AR processes and testing of hypotheses for coefficient matrices of such processes.

Monomial curves and invariants associated to them

Clare D'Cruz

Chennai Mathematical Institute

Recently, symbolic powers of ideals have been of interest. However the generators are hard to describe. Hence one would like to compare the symbolic powers and ordinary powers. In order to compare them, C. Bocci and B. Harbourne defined certain asymptotic quantities like the resurgence and Waldshmidt constant. In this talk we will describe the quantities for certain monomial curves.

Bracket generating distributions and the space of horizontal curves

Mahuya Datta

Indian Statistical Institute Kolkata

A distribution \mathcal{D} on a manifold M assigns to every point $x \in M$ a k -dimensional subspace in the tangent space at x . \mathcal{D} is said to be bracket generating if the successive Lie brackets of vector fields in \mathcal{D} generate the whole tangent bundle. Bracket generating distributions lie at the opposite end of the involutive distributions. Chow's theorem shows that if \mathcal{D} is bracket generating then any two points of M can be joined by a path whose velocity vector is always tangent to \mathcal{D} . Such curves are called horizontal curves.

Contact distributions are certain co-rank 1 distributions which can exist only on odd-dimensional manifolds. They form an important class of bracket generating distributions. In this lecture we shall review the h -principle of horizontal maps into Contact and Engel manifolds and then discuss about some possible extensions for co-rank 2 distributions.

Modular Forms and Galois Representations

Ekmath Ghate

Tata Institute of Fundamental Research Mumbai

Modular forms and their Galois representations show up in the solutions of many classical problems in number theory, such as Fermat's Last Theorem, the Congruence Number Problem, the Sato-Tate Conjecture etc. Such modular Galois representations can be studied for their own sake. Here are two open problems:

1. The splitting question, when the slope is zero, and,
2. The reduction problem, when the slope is positive.

Much insight can be gained into both problems by introducing p -adic families of modular forms. In this mini-course, we will describe such families, and show how they can be used to obtain information towards solving the above problems. While this course will be introductory, we hope to also touch upon some theorems that the speaker has been involved with.

Stability of quadratic curvature functionals at product of Einstein manifolds

Soma Maity

Indian Institute of Science Education and Research, Mohali

Consider Riemannian functionals defined by L^2 -norms of Ricci curvature, scalar curvature, Weyl curvature and Riemannian curvature. I will talk about rigidity, stability and local minimizing properties of Einstein metrics and their products as critical metrics of these quadratic functionals. We prove that the product of a spherical space form and a compact hyperbolic manifold is unstable for certain quadratic functionals if the first eigenvalue of the Laplacian of the hyperbolic manifold is sufficiently small. We also prove the stability of L^2 -norm of Weyl curvature at compact quotients of $S^n \times H^m$.

Stability of Lazarsfeld-Mukai bundles

Poornapushkala Narayanan

Tata Institute of Fundamental Research Mumbai

Lazarsfeld-Mukai bundles are an important class of vector bundles on complex projective varieties which were introduced by Lazarsfeld and Mukai in the 1980s. They are constructed using the standard technique of elementary transformations and have found applications in studying syzygies and Brill-Noether theory. In this talk we discuss the construction of these bundles and some of their properties. In particular we focus on the stability of these vector bundles over certain projective varieties like projective spaces, abelian surfaces etc. We will also highlight some of the applications of Lazarsfeld-Mukai bundles.

The Kneser Conjecture and Hom Complexes

Nandini Nilakantan

Indian Institute of Technology Kanpur

In 1978 Lovasz proved the famous Kneser Conjecture, proposed in 1954, using topological methods. In this work, he also introduced certain simplicial complexes called Hom-complexes. In this talk, I will give a brief proof of the Kneser Conjecture using the Borsuk Ulam Theorem. I will also discuss Hom Complexes and present some related results.

A Finite Element Method for Elliptic Distributed Optimal Control Problems with Pointwise Control and State Constraints

Kamana Porwal

Indian Institute of Technology Delhi

In this talk, we analyze a nonconforming finite element method for elliptic distributed optimal control problems with pointwise state and control constraints. The state control constrained minimization problem is solved for the state variable by reducing it into a fourth order variational inequality and convergence of the state error is established in the H^2 -like energy norm. The key ingredients are constraint preserving properties of the interpolation operator and the enriching map. We also discuss post-processing methods to obtain the approximation of the control from the discrete state. Numerical results are presented to illustrate the theoretical findings.

Beyond Parseval's identity

Mythily Ramaswamy

TIFR Centre for Applicable Mathematics, Bengaluru

Parseval's identity is a fundamental result in Hilbert spaces. In particular, it gives the summability of the Fourier series for a function. We discuss some generalizations of this identity and applications in control of partial differential equations.

Lie Nilpotent Group Algebras

Meena Sahai

Lucknow University

The non-commutative group algebra KG of a group G over a field K is Lie nilpotent if and only if the characteristic of K is a prime number p and G_0 is a finite p -group. We explore the structure of the group G when the Lie nilpotency index of KG is given. The Lie nilpotency index $tL(KG)$ and the strong Lie nilpotency index $tL(KG)$ of KG are equal if $p > 3$. However, for $p < 3$ this is still an open problem. We look into this aspect also.

Variants of equidistribution in arithmetic progression

Akshaa Vatwani

Indian Institute of Technology Gandhinagar

It is well known that the prime numbers are equidistributed in arithmetic progression. Equidistribution in arithmetic progression is also observed more generally for a class of multiplicative functions. We derive some variants of such results and give an application to tuples of squarefree integers in arithmetic progression. We also discuss an interesting application that relates to the Chowla conjecture on correlations of the Möbius function, and show its relevance to the twin prime conjecture.

Paper Presentations

Induced Signed Graphs of Some Classes of Graphs

Achu Aniyani

Christ (Deemed to be) University, Bengaluru

A signed graph is a graph with positive or negative signs assigned to edges. An induced signed graph is a signed graph constructed from a given graph according to some pre-defined protocols. A degree-induced signed graph or d-induced signed graph is a signed graph in which each edge uv receives a sign $(-1)^{|d(v)-d(u)|}$, where $d(u)$ represents the degree of vertex u . Similarly an eccentricity-induced signed graph or an e -induced signed graph is a signed graph in which each edge uv receives a sign $(-1)^{|e(v)-e(u)|}$, where $e(u)$ is the eccentricity of the vertex u . In this paper we determine the properties of degree induced and eccentricity induced signed graphs such as balancing, clustering, regularity and co-regularity.

On existence of solution of First order problems with nonlinear boundary conditions

Aradhana Santosh Bandekar

Goa University

This paper discusses the existence of a solution for first order problems with nonlinear boundary conditions between lower and upper solution.

A Common Generalization Among Convolved Lucas First Kind and Generalize Lucas Second kind Polynomials

Adikanda Behera

Sambalpur University

We introduce the generalized (p, q) -Lucas second kind polynomials. Specifically, the generalized (p, q) -Lucas second kind polynomials $\{M_{p,q,j}(x)\}_{j \in \mathbb{N}}$ are defined recursively by

$$M_{p,q,0}(x) = M_0, \quad M_{p,q,1}(x) = M_1, \quad M_{p,q,j+1}(x) = p(x)M_{p,q,j}(x) + q(x)M_{p,q,j-1}(x), \quad j \geq 1,$$

where $p(x)$ and $q(x)$ are polynomials of real coefficients and M_0 and M_1 are taken as zero and first terms of Lucas second kind like sequences. Their generating functions are given by

$$\sum_{j=0}^{\infty} M_{p,q,j}(x)t^j = \frac{M_0 + (M_1 - p(x)M_0)t}{1 - p(x)t - q(x)t^2}, \quad \sum_{j=0}^{\infty} M_{p,q,j+1}(x)t^j = \frac{M_1 + q(x)M_0t}{1 - p(x)t - q(x)t^2}.$$

The common convolved (p, q) -Lucas first and generalize Lucas second kinds polynomials $E_{p,q,j}^{(r,m)}(x)$ for positive integers r and m are defined by

$$\sum_{j=0}^{\infty} E_{p,q,j}^{(r,m)}(x)t^j = \frac{(M_1 + q(x)M_0t)^m}{(1 - p(x)t - q(x)t^2)^r}, \quad r \geq m. \quad (*)$$

We have found out some amazing properties relating to the equation (*).

Unreliable retrial queue with priority customers and discouragement

Amita Bhagat

Jaypee Institute of Information Technology, Noida

This investigation deals with unreliable retrial queue with infinite capacity. The customers on seeing the server busy may join a virtual pool of customers called orbit from where they retry after random interval of time for service. The customers may also get discouraged on seeing long waiting queue in front of them. The system analyzes the arrival of two type of customers, priority customers and ordinary customers. Using supplementary variable technique the analytic expressions for various performance measures have been obtained and numerical analysis has also been done using MATLAB.

Expansivity of the action of an automorphism of G on Sub_G

Prajapati Manojkumar Bhagubhai

Jawaharlal Nehru University, New Delhi

Let G be a locally compact metrizable group. The space Sub_G is the collection of all closed subgroups of G , equipped with the Chabauty topology. We show that any infinite compact group G does not admit any automorphism which acts expansively on Sub_G . We also show that if any automorphism of an infinite group G acts expansively on Sub_G then G is non-compact and totally disconnected. We illustrate an example of an automorphism of a totally disconnected group G which acts expansively on Sub_G .

Discontinuity Locator for hybrid Weighted Essentially Non-oscillatory Schemes

Ashlesha A Bhise

Visvesvaraya National Institute of Technology, Nagpur

An efficient capturing of shocks is one of the most challenging tasks involved in solving hyperbolic conservation laws. Many numerical schemes have been employed for the same out of which one of the well-known scheme is the weighted essentially non-oscillatory(WENO) scheme. However, this WENO scheme and its allies involve a costly WENO reconstruction procedure. In classical WENO scheme, WENO reconstruction is implemented on the entire spatial domain. If it can be restricted to only the less smooth regions, we can obtain a computationally cheaper version of the WENO scheme, resulting in a hybrid WENO scheme. In this work, we have proposed problem independent discontinuity locator for third and fifth order WENO schemes. These are designed based on the smoothness indicators. Numerical results have been included to verify the computational time taken for various test cases in scalar, one-dimensional and two-dimensional hyperbolic equations.

Fuzzy Dynamical System in SEIR epidemic Modal

Gauri Bhujju

Kathmandu University, Nepal

Epidemic disease are posing constant threat to humans worldwide. It is necessary to understand their transmission dynamics to propose the control strategies. In the present work, fuzzy approach is used to study transmission dynamics of epidemic disease using SEIR (Susceptible, Exposed, Infectious and recovered) compartmental model. Transmission rate and recovery rate of the disease are considered as a fuzzy members. Also, the fuzzy basic reproduction number for group of infected individuals with different virus loads is calculated. Simulation are made to illustrate the mathematical results graphically. Keywords: SEIR model, fuzzy members, epidemic disease, basic reproduction number.

Cube-free groups with GAP applications

Deepshikha Chatterjee

Ambedkar University, Delhi

By cube-free groups we mean groups of order not divisible by a prime cube. Our aim is to describe the structure of these groups and develop an algorithm to construct them up to isomorphism. Further, we give a classification and a GAP implementation.

Study of Non Newtonian fluid models and their applications

Yogesh Dadhich

Manipal University, Jaipur

Many fluids of industrial importance are non- Newtonian. It is now generally recognized that, in real industrial applications, non-Newtonian fluids are more appropriate than Newtonian fluids, due to their applications in petroleum drilling, polymer engineering, certain separation processes, manufacturing of foods and paper and some other industrial processes. In a non-Newtonian fluid, the local shear stresses and the local shear rates in the fluid have a non-linear relation, where a proportionality constant cannot be defined. Therefore, the Viscosity is not a fixed scalar but a variable. Further it is also important to note that the viscosity can be dependent on the shear rate or the time history of shear rate.

Some examples are fluid substances like ketchup, custard, toothpaste, starch suspensions, paint, blood, and shampoo etc. Few widely used non-Newtonian fluid models are Power Law Model, Carreau Model, Sisko Model, Herschel-Bulkley Model, Casson, Powell-Eyring, Jeffrey & Williamson fluid model. In this paper some are discussed in detail.

Role of Thalamus in reorganisation of cortical hubs with aging

Moumita Das

National Brain Research Centre, Manesar

The human brain undergoes both structural and function changes across the lifespan. It is important to know the dynamics of these changes. On average, functional connections within resting-state networks weaken in magnitude while connections between resting-state networks tend to increase with age. A very recent study by Tsvetanov et.al(2016) shows that effective connectivity within and between large scale functional networks changes over the healthy lifespan. Inspired by these studies we move one step forward to investigate the effect of thalamus in context of healthy aging. Till date few studies have specifically investigated how thalamo cortical structural and functional connectivity changes with age and how such changes are associated with changes in cognitive functions (Goldstone 2017). Using effective connectivity measures on resting state fMRI data, we examine the age related changes in both cortical and thalamo cortical causal interactions within and between resting state networks. RS fMRI as well as corresponding diffusion weighted (dw) MRI data were collected for 25 young and 24 elderly individuals. Datas are preprocessed using the virtual brain pipeline. Finally we selected 68 cortical regions and subcortical thalamic regions using Desikan Killiany parcellation atlas. Various centrality measures are applied on average FC and SC matrix for finding out the most central nodes(hubs). Community structure of these matrices are identified using the algorithm by Blondel et al.(2008). The three of core cognitive networks DMN, SN, CEN networks are identified by spatially matching of hub regions with the important RSNs in the literature. Multivariate GCA is performed to test for causality index between ROIs with and without the thalamus. Pairwise granger causality indexes are calculated for within network and between network causality analysis. We have also tested the statistical significance of estimated causality against the zero causality. We have also calculated the distribution of weighted net granger causal outflow with the 100 bootstrap sample of Granger Causality matrix. We have performed nonparametric Mann-whitney U test to test Whether there is any significance difference between net causal outflow for two different age groups with and without the thalamus. In structural and function connectivity analysis we have found that structural modularity prevails better than functional modularity with aging. Also reorganisations

of functional hubs are going on with the age. In context of effective connectivity, we see that causal connections are changing with age. Within network causal connections become weaker, but between network causal connections are getting stronger with aging. Net causal outflows of several nodes are significantly higher in young compared to old population for within network analysis. Significant changes are seen in causal connections and net causal outflows in presence of thalamus. To our knowledge no previous study have addressed the role of thalamus in causal connectivity analysis for resting state networks. We have shown that thalamus has important causal role in within network and between network analysis. This influence also changes with aging. Our findings with the effective connectivity measures strengthens the hypothesis that balancing between within network connectivity and between network connectivity is important to maintain the functionality of brain, with aging.

Linear independence of harmonic numbers

Sonika Dhillon

Indian Institute of Technology Ropar

Let H_n denote the n^{th} harmonic number. Euler extended it to the whole complex plane except for the non-negative integers where it has a simple pole of residue -1 . In this presentation, we explore the linear independence of harmonic numbers and establish the results to a more general case. More precisely, we obtain the dimension of space generated by these harmonic numbers at rational arguments whose denominator is either prime powers or product of two distinct primes. In fact, let J be any finite set of positive integers with $|J| = n$, satisfying some necessary conditions and define W as the vector space spanned by the harmonic numbers whose denominator lies in the set J over the field of algebraic numbers. Then, $\dim W \leq \sum (\phi(q_i)/2) + n + 2$, where $1 \leq i \leq n$ and $q_i \subset J$.

A tale of two cones since Hilbert's 1888 theorem

Charu Goel

Indian Institute of Information Technology Nagpur

The relationship between the cone of positive semidefinite (psd) real forms and its subcone of sum of squares (sos) of forms is of fundamental importance in real algebraic geometry and optimization, and has been studied extensively. The study of this relationship goes back to the 1888 seminal paper of Hilbert, where he gave a complete characterisation of the pairs $(n, 2d)$ for which a psd n -ary $2d$ -ic form can be written as sos. In this presentation, we will show how this relationship changes under the additional assumptions of symmetry on the given forms. We will present our recent results giving the analogues of Hilbert's characterisation for symmetric and even symmetric forms respectively. Along the way, we will also discuss briefly how test sets for positivity of symmetric polynomials play an important role in establishing these analogues. (Joint work with S. Kuhlmann and B. Reznick)

A Remark on extension of a monoidal structure

Neha Gupta

Shiv Nadar University

This paper concerns a functor $T : C \rightarrow D$, where C is monoidal. We give conditions on T , which ensure that $Im(T)$ makes sense as a subcategory of D and inherits a monoidal structure from C . We make a similar claim in the symmetric case. Next we consider retracts D of $C^{(\Lambda)}$ for some indexing set Λ and a (symmetric) monoidal category C (with left and right duals) and give conditions when D is (symmetric) monoidal as well (having left and right duals.)

On representation of solutions for the theory of generalized thermoelasticity under modified Green-Lindsay model

Manushi Gupta

Indian Institute of Technology (BHU), Varanasi

The present work is an attempt to derive the representation of a Galerkin-type solution in the context of the recently modified Green-Lindsay model for an isotropic and homogeneous medium. This model involves strain rate term other than temperature rate in the constitutive equations. At first, the theorem quoting the representation of Galerkin-type solution of equations of motion in the present context is obtained. Then, the representation theorem of Galerkin type of system of equations for steady oscillation is proved. In accordance with this theorem, we finally establish a theorem which expresses the general solution of the system of homogeneous equations of steady oscillation in terms of metaharmonic functions.

A new finite-difference method for fractional differential equations

Aman Jhinga

Savitribai Phule Pune University, Pune

A new finite-difference predictor-corrector method (L1 - PCM) to solve nonlinear fractional differential equations (FDEs) is presented along with its error and stability analysis. The method is further extended for systems of FDEs. The proposed method is applied to fractional version of chaotic system introduced by Bhalekar and Daftardar-Gejji to explore its rich dynamics. The proposed method is accurate, time-efficient and performs well even for very small values of the order of the derivatives.

Prediction of Monthly Rainfall By Artificial Neural Networks

Manjusha Kulshrestha

Anand Agricultural University, Anand

Artificial neural networks are non-linear models and have been shown to be effective in the field of prediction of weather parameters or weather forecasting as these techniques are of much interest because they allow modeling of time-dependent hazards. Here, an attempt has been done to predict the monthly rainfall from June to September of Anand station, Gujarat by ANN. Inputs were monthly maximum temperature and relative humidity. To predict the monthly rainfalls from June to September monthly data series of i) Max temperature of month May(MaxT), ii) rainfall(RF), iii) relative humidity(RH) and iv) wind speed(WS) observed at Anand station from the year 1979-2018 was used. Here, ANN consists of three layers. Those are input layer, hidden layer and output layer. Input layer and output layer has one and three neuron respectively. Inputs were current year of maximum temperature of month of May and previous year related monthly Rainfall, Mean Relative humidity, Wind speed and output is current year rainfall. Used functions were Leven berg-Marquardt Back Propagation , Gradient Descant with Bias Learning , Mean Square Error and Tangent Sigmoid transfer function as Training function, learning function, Performance function and Transfer function respectively with ten number of neurons. Found results were significant to actual occurred rainfall.

Application of Graceful labeling techniques in Hexagonal Snakes along a path

P. Lalitha

SRM University

Graceful Labeling techniques find its application in various fields. In this article, I have applied graceful labeling in a series of hexagons joined one with the other through a vertex forming Hexagonal Snakes. These n number of Hexagonal Snakes are attached along a path. Graceful Labeling of vertices and edges can be done for these Hexagonal Snakes along a path.

Finite Difference Approach to Study the Heat Transfer in Human Body through Clothes

Kabita Luitel

Tribhuvan University, Nepal

Clothing plays an important role by working as thermal insulation and controlling the heat transfer from both, body to environment and environment to the body. So the main aim of the study is to observe the heat transfer from the surface of the skin to the environment via clothes. Clothes considered as a protective layer. Various physical and physiological parameters across the layers of skin along with clothing area factors and clothing insulation in the protective layer have been incorporated in the model. Finite Difference Technique is used to solve the reformulated form of one-dimensional Pennes bio-heat equation with appropriate boundary conditions. The numerical results are illustrated in graphs to clear that the protective layer maintains a suitable temperature at the skin surface regardless of the surrounding temperature. Keywords: Thermal insulation, Layers of skin, Finite Difference Technique, Protective layer

A note on primitive roots of p^ℓ for all $\ell \geq 1$

Makeshwari M.

Central University of Tamil Nadu

In this presentation, the motivation is to estimate the number of primitive roots of p which are also the primitive roots of p^2 . It is easy to observe that 29 is the minimal counter example such that 14 is a primitive root of 29 and it is not a primitive root of 29^2 . Therefore, it leads to a natural question such that whether there exist infinitely many primes p for which the primitive roots of p are also the primitive roots of p^2 ? We present our arguments answering this question, using the relation connecting non-Wieferich primes and primitive roots, abc conjecture and Artin primitive root conjecture. Further, we present a sufficient condition for a to be a primitive root of p^ℓ for all integers $\ell \geq 1$ and for any odd prime p . We also present the existence of such primitive roots.

Discontinuous Galerkin Finite Element Methods for the Landau-de Gennes Minimization Problem of Liquid Crystals

Ruma Rani Maity

Indian Institute of Technology Bombay

We consider a system of second order non-linear elliptic partial differential equations modeling the equilibrium configurations of a two dimensional planar bistable nematic liquid crystal device. The discontinuous Galerkin finite element methods to approximate the regular solutions with non-homogeneous Dirichlet boundary conditions is analyzed. A discrete inf-sup condition has been established which demonstrates the stability of the discontinuous Galerkin discretization of a well-posed linear problem. The existence and local uniqueness of discrete solution of the non-linear problem is an application of Brouwer fixed point theorem using discrete inf-sup conditions. A priori error estimates in the energy norm has been derived.

Importance of Inventory Control and Management

Ajender Kumar Malik

B K Birla Institute of Engineering and Technology, Pilani

In current years, mathematical concepts have been practiced in different areas in real life problems, mainly for controlling inventory. Holding and managing of an inventory item is essential for efficient and smooth running of any business organization which may be a manufacturing industry, a five star hotel, a printing press or a hospital. The most significant purpose helped by the stores is to offer the nonstop service to the producing divisions. Inventories represent a substantial portion of the total assets of a company and considerable effort is required to control the inventories. The current presentation discusses the nature and role of Inventory in day to day life. One of the most important concerns of the management of any organization is to decide when and how much to order or to manufacture so that the total cost associated with the inventory system should be minimum. Many companies fail each year due to the lack of acceptable control of the inventories. Whether it is raw materials used to manufacture a product or products waiting to be sold, problems arise when too few or too many items are held in inventory.

Estimation of Parameters of Population Dynamic models using Gibbs Sampling

Dipali Vasudev Mestry

Institute of Chemical Technology, Mumbai.

Biological growth models are fundamental in understanding the population growth in natural environment and are very important for the prediction of population status. Growth models are abundant in the literature. Several highly nonlinear and multidimensional models have been proposed. Usually, the nonlinear least squares methods are used to estimate the parameters and the associated uncertainty is captured by Hessian Matrix through the use of Newton Raphson method. Due to high level of nonlinearity in many models, the accuracy of this method is poor and the confidence intervals for the parameters are very large in such cases. We adopt a simple Bayesian procedure to estimate the parameters. The method is based on the Gibbs sampling, where the posterior samples are generated using the conditional distribution rather than the joint distribution. Where the marginal posterior density function is not known, grid approximation has been utilized to approximate the density function. Utility of this method has been shown using several simulated data sets. Real data sets of single and interactive population dynamics have been used as case study. Keywords: Grid approximation, Likelihood, Posterior distribution, credible intervals

***n*-Kirchhoff equations involving Choquard type exponential nonlinearity**

Tuhina Mukherjee

TIFR Centre for Applicable Mathematics, Bengaluru

We consider an elliptic partial differential equation of Kirchhoff type in \mathbb{R}^n involving the n -Laplace operator and exponential critical nonlinearity in the sense of Hardy-Littlewood-Sobolev inequality and show the existence of a weak solution to it using the variational technique. Moreover, we show that if we consider a boundary value value of this type, particularly, involving concave-convex type nonlinearity then the problem admits atleast two weak solutions.

Distal action of automorphisms of a lattice G on $Sub(G)$

Rajdip Palit

Jawaharlal Nehru University, New Delhi

Let Γ be a finitely generated, nilpotent, discrete group. Let $T \in Aut(\Gamma)$. Then T acts distally on Sub_Γ if and only if $T^n = Id$ for some $n \in \mathbb{N}$. We first study lattices in a simply connected nilpotent group G . The group Γ as above has a quotient by a finite group, which is a lattice in such a group G .

Mathematical modelling and numerical simulation of blood flow through a stenosed artery in presence of external oriented magnetic field

Salma Parvin

Bangladesh University of Engineering and Technology

Various problems such as heart attacks and strokes are related to blood flow and also the physical characteristics of the artery wall. The hemodynamic instability behavior of the blood flow is influenced by the presence of arterial stenosis. The study of blood flow in the artery has some important aspects due to bio-medical engineering application. The magnetic field imposition through blood flow may be helpful in the field of vascular surgery for proper circulation of blood by controlling blood flow. In this paper, development of a mathematical model regarding non-Newtonian blood flow considering shear rate dependent viscosity through a stenosed artery in presence of magnetic field is shown and solution technique of the model using finite element method is described. Some results of numerical simulation are shown for the blood flow through a regular artery, a stenosed artery and a bypass grafted artery in terms of the velocity profile, pressure distribution and shear rate.

Numerical approach to study the characteristics of Porous Journal bearings using couple-stress fluid

Shalini M. Patil

JSS Academy of Technical Education, Bengaluru

This paper theoretically examines the combined effects of couple-stress fluid and permeability for non-porous journal revolving with constant tangential velocity in a rough porous bearing. The lubricating fluid is assumed to be couple-stress fluid. The governing equations are solved by using the appropriate boundary conditions. The generalized average modified Reynolds equation is solved using finite difference based multigrid method. The bearing characteristics such as pressure distribution, load carrying capacity for various values of couple-stress parameter and permeability are studied. It is observed that pressure distribution and load carrying capacity is predominant for couple-stress fluid compared to the classical Newtonian case.

Analytical Solution of Dirichlet problem involving Laplace's equation for various closed smooth curves

Madhavi Rao

Indian Institute of Science

A simple method of solution developed to handle Dirichlet problem for two dimensional Laplace's equation is examined here for various known curves which otherwise cannot be handled easily for solution. The solution methodology examined here for various known curves comes out as an effective method in the absence of an analytical method of solution like that of Green's function technique for different closed smooth curves. Also, certain curves are generated and solution of Dirichlet problem involving closed regions bounded by such curves are determined. The associated numerical results are presented in tabular form.

Two-warehouse inventory model with quantity discount policy

Himanshu Rathore

Manipal University, Jaipur

In present study a two-warehouse inventory model is established for deteriorating items. Controllable deterioration rate under the effect of preservation technologies. The market environment is such that the demand is received according to linear function of advertising frequency and selling price. Quantity discount policy is presented to keep bond of customer solid. The selling price, total cycle length and preservation cost parameters are taken as decision variables. The study is numerically verified with suitable graphical representation.

p-adic valuation of *k*-balancing and *k*-Lucas-balancing numbers

Prasanta Kumar Ray

Sambalpur University, India

A natural number n is a balancing number with the balancer r if they are the solution of a simple Diophantine equation $1 + 2 + \dots + (n - 1) = (n + 1) + (n + 2) + \dots + (n + r)$. Balancing numbers B_n satisfy the linear recurrence $B_n = 6B_{n-1} - B_{n-2}$ for $n \geq 2$ with initials $B_0 = 0, B_1 = 1$, where B_n denotes the n^{th} balancing number. For any balancing number B_n , the positive square roots of $8B_n^2 + 1$ also generate a sequence known as Lucas-balancing sequence $\{C_n\}_{n \geq 0}$. Lucas-balancing sequence satisfies the same recurrence as that of balancing sequence but with different initials, that is, $C_n = 6C_{n-1} - C_{n-2}$ for $n \geq 2$ with $C_0 = 1$ and $C_1 = 3$. For any positive integer k , the k -balancing sequence $\{B_{k,n}\}_{n=0}^{\infty}$ is defined recursively by $B_{k,n+1} = 6kB_{k,n} - B_{k,n-1}, n \geq 1$ with initials $B_{k,0} = 0, B_{k,1} = 1$. The companion of k -balancing sequence, k -Lucas-balancing sequence $\{C_{k,n}\}_{n=0}^{\infty}$ satisfies the same recursive relation as that of k -balancing sequence but with different starting values, that is,

Uniqueness of complex meromorphic functions sharing a small function

Rajeshwari S.

Presidency University, Bengaluru

Let f and g be two transcendental meromorphic functions in \mathbb{C} ; let P be a polynomial of uniqueness for meromorphic function in \mathbb{C} and let α be a small meromorphic function with respect to f and g : With the notion of weakly weighted sharing and relaxed weighted sharing for the function $f'P'(f)$ and $g'P'(g)$, we show that $f = g$ provided that the multiplicity order of zeros of P' satisfy certain inequality. There is no additional condition on α : We consider the particular case of entire functions.

Elliptic Partial Differential Equations involving polynomial/exponential type nonlinearities with sign changing weight functions

Sarika

Bennett University, Greater Noida

The talk is concerned about the existence and multiplicity results of elliptic equations involving polynomial/exponential type nonlinearities with sign changing weight functions. The fibering map analysis and Nehari method play an important role to obtain the existence and multiplicity of weak solutions for such type of elliptic equations. I will explain this analysis and also would like to discuss the extension of this technique to non-local elliptic equations involving p-fractional Laplace operator.

On the Dirichlet-Neumann First Eigenvalue of a Family of Polygonal Domains

Acushla Sarswat

Jawaharlal Nehru University, New Delhi

Let p_1 and p_0 be closed, regular, convex, concentric polygons having n sides in \mathbb{R}^2 such that p_0 is contained in the interior of p_1 . We fix p_1 and vary p_0 by rotating it about its center. Let Ω be the interior of $p_1 \setminus p_0$. In this paper we examine the critical points of the first Dirichlet-Neumann eigenvalue $\lambda_1(\Omega)$ through a variation of the domain, which is shown to be differentiable using an analogue of the Poincaré Inequality, derived for functions vanishing on ∂p_0 .

Statistical approximation by $(p;q)$ -analogue of Bernstein-Stancu Operators

Vinita Sharma

Aligarh Muslim University

In this paper, some approximation properties of $(p;q)$ -analogue of Bernstein-Stancu Operators are studied. Rate of statistical convergence by means of modulus of continuity and Lipschitz type maximal functions has been investigated. Monotonicity of $(p;q)$ -Bernstein-Stancu Operators and a global approximation theorem by means of Ditzian-Totik modulus of smoothness established. A quantitative Voronovskaja type theorem is developed for these operators. Furthermore, we show comparisons and some illustrative graphics for the convergence of operators to a function.

Semi-infinite moving crack in an orthotropic strip sandwiched between two identical half planes

Anuwedita Singh

Indian Institute of Technology (BHU), Varanasi

The problem of semi-infinite moving crack situated in an orthotropic strip sandwiched between two identical half planes has been considered. The considered boundary value problem has been solved to convert it into the standard Wiener-Hopf equation by using Fourier transform technique. Further the Wiener-Hopf equation has been solved to obtain analytical expression for stress intensity factor and crack opening displacement at the tip of the crack. The effects of elastic material constants and width of the strip h on stress intensity factor and crack opening displacement at the tip of crack have been displayed graphically for various particular cases for a combination of orthotropic materials.

Region of Variability for a class of univalent functions

Kavitha Sivasubramanian

SDNB Vaishnav College for Women, Chennai

We denote by H the class of analytic functions in the unit disk D and think of H as a topological vector space endowed with the topology of uniform convergence over compact subsets of D . In the present work, we define a new class of univalent functions (that are closely related to the exponentially convex univalent functions) and determine region of variability of the defined class when f belongs to a particular favoured class of function with a few restriction. Geometrical Illustration of the region of variability of the class under consideration for several sets of parameter using Mathematica are also given.

Review on Evolution of Fractional Order Differential Equations and their Solutions

Anju Sood

Sant Baba Bhag Singh University, Padhiana

Due to its application in varied fields of science, engineering and economics, the subject of fractional calculus has become an attraction to massive community of researchers. The fractional derivatives and integrals enable the description of the memory and hereditary properties. In this paper we review the literature about the evolution of fractional order differential equations. By considering different definitions of fractional derivatives, we discuss some kind of fractional differential equations and few methods of solving fractional order differential equations. Their applications in Economics has also been talked about.

Numerical solutions of third order dispersive partial differential equation using splines

Talat Sultana

Lakshmibai College, University of Delhi

In this paper, the linear third order dispersive partial differential equation is considered for numerical solution using spline function approximation. Exponential quartic spline is used in space and finite difference discretization in time. The developed method is tested on two problems from the given literature. Also, the truncation error of the presented method is investigated.

Solutions for Quasi-Variational Inequalities with unbounded constraint map

Asrifa Sultana

Indian Institute of Technology Bhilai

We establish the existence of solutions for quasi-variational inequality problems with a constraint map which is not necessarily bounded valued. The coercivity conditions play the major role in our results. An application to generalized Nash equilibrium problem has provided.

Some results on system of q-shift complex differential-difference equations

A. Tanuja

Siddaganga Institute of Technology, Tumkur

By using the Nevanlinna theory of value distribution, we investigate the growth and existence of meromorphic solutions to system of q-shift complex differential-difference equations whose coefficients are small functions of meromorphic function. Our results show that the Nevanlinna theory provides a powerful mathematical tool for solving system of equations.

On existence of fixed point in C^* -algebra valued partial metric spaces and its applications to real world problems

Anita Tomar

Government Degree College Raipur, Dehradun

The aim of this talk is to discuss the existence of fixed point in the setting of C^* -algebra valued partial metric space and to illustrate the theoretical finding with the help of numerical examples. Motivated by the importance of two-point boundary value problems in the study of the real world problems, for instance hanging cable problem plays a crucial role in designing crane lifts and booms, we solve boundary value problems to demonstrate the feasibility of our results.

Uniqueness of Polynomial and Differential Monomial

Husna V.

Presidency University, Bengaluru

In this paper, we discuss the problem of meromorphic functions sharing small function and present one theorem which extend a result of K.S.Charak and Banarasi Lal

Transpiration on chemically reacting MHD Thixotropic fluid flow due to penetrable stretching cylinder with nanoparticles with thermal radiation

Nagendramma V.

Presidency University, Bengaluru

The impact of transpiration parameter on chemically reacting, steady boundary layer flow, heat and mass transmission of MHD Thixotropic nanofluid over a permeable stretching cylinder subject to heat source/sink and thermal radiation is examined numerically. The effect of Brownian motion and thermophoresis diffusion are employed in the modeling of heat and mass transport phenomenon. The solutions for desired equations are obtained by using Runge-Kutta-Fehlberg method with bvp5c technique. Numerical evaluations have been accomplished for disparate values of physical constraints at three distinct transpiration parameters with a set of delineates. Moreover, the coefficient of drag force, local Nusselt and Sherwood numbers have been evaluated for disparate parameters and examined for engineering interest. It is worth mention that the thixotropic material parameters show enhancing nature on velocity while it elucidates paradoxical manner. We noticed that there is a more reduction in the temperature in impermeable case when compare to remaining two cases suction and injection

Comparative study of Adomian decomposition method for solving differential equations in ordinary and partial differential equations of Fractional order

Pratibha Verma

In this paper, we investigate the method for solving linear and non-linear partial differential equations of fractional order. The Adomian Decomposition Method is one of the reliable and popular method for solving linear and non-linear differential equations and provides solutions in the form of series. In this study, our main purpose is to achieve more accurate and fast convergent solution with less iterations. Here we adopt Two-Step Adomian Decomposition Method (TSADM) for solving linear and non-linear partial differential equations of fractional order and compared with Variation Iteration Method. It is successfully applied to autonomous linear and non-linear partial differential equations with variable coefficients. It is shown that TSADM is more effective and promising method with one iteration and provides exact solution of both the problems without discretization and linearisation.

Poster Presentations

Dilatant Fluid and its applications

Reema Jain

Manipal University, Jaipur

A Dilatant Fluid(also termed shear thickening fluid STF) is a non- Newtonian fluid where the shear viscosity increases with applied shear stress. This behavior is only one type of deviation from Newtons Law and it is controlled by such factors as particle size, shape and distribution. The properties of these suspensions depend on Hamaker theory and Van der Waals forces and can be stabilized electrostatically. Shear thickening behavior occurs when a colloidal suspension transitions from a stable state to a state of flocculation. This can readily be seen with a mixture of cornstarch and water (sometimes called Ooblek), which acts in counter intuitive ways when struck or thrown against a surface. Sand that is completely soaked with water also behaves as a dilatant material. This is the reason why when walking on wet sand, a dry area appears directly underfoot. Rheopecty is a similar property in which viscosity increases with cumulative stress or agitation over time.

Mathematical Modelling of antibiotic drug resistance integration socio-economic growth and antibiotic misuse

Bhawna Malik

Shiv Nadar University

In this paper, we developed model of drug-resistance integrating socio-economic growth, population ecology of infectious disease, and antibiotic misuse. Studies pointed out that the ever-increasing antibiotic consumption is one of the primary drivers of community-acquired antibiotic drug-resistance, especially in middle and lower income countries. We show that combined impact of economy, infections, and self-medication yield synergistic interactions through feedbacks on each other, presenting emergence of drug-resistance as

a self-reinforcing cycle in the population. Analysis of our model not only determines the threshold of antibiotic use beyond which the emergence of resistance may occur, but also characterises how fast it develops depending on economic growth, and lack of education and awareness of the population.

Genetic Algorithm for Heterogeneous Vehicle Routing Problem

Barnali Saha

Vivekananda Education Society's Institute of Technology, Mumbai

This paper aims at solving a Generalized Capacitated Vehicle Routing Problem (GCVRP) for a single-trip homogeneous and heterogeneous fleet. The algorithm is applied on a multinational company's bus service routes in Mumbai, India. The algorithm optimizes: (a) the number of vehicles used to transport the employees scattered at various nodes to a central node by minimizing the total Inter-distances and (b) the overall cost that includes the fixed cost and the variable cost associated with the type of vehicle. The proposed optimization is based on the cellular Genetic Algorithm (cGA). The results of the algorithm are compared to the benchmark instances in the literature like Augerat et al. (1995) and Christofides et al. (1979) and have proved to be competitive. The results additionally show a considerable improvement of average 2.8% over the solution obtained by applying the heuristic Augmented Savings Algorithm (ASA) proposed by us for the case study comprising 53 nodes. Our earlier work based on ASA is presently under publication.

Transitivity of non-autonomous discrete systems via Furstenberg families

Radhika Vasisht

Delhi University

We study necessary and sufficient conditions for different non-autonomous systems to be F-transitive and F-mixing, where F is a Furstenberg family. We further provide examples/counter examples in support of our results.

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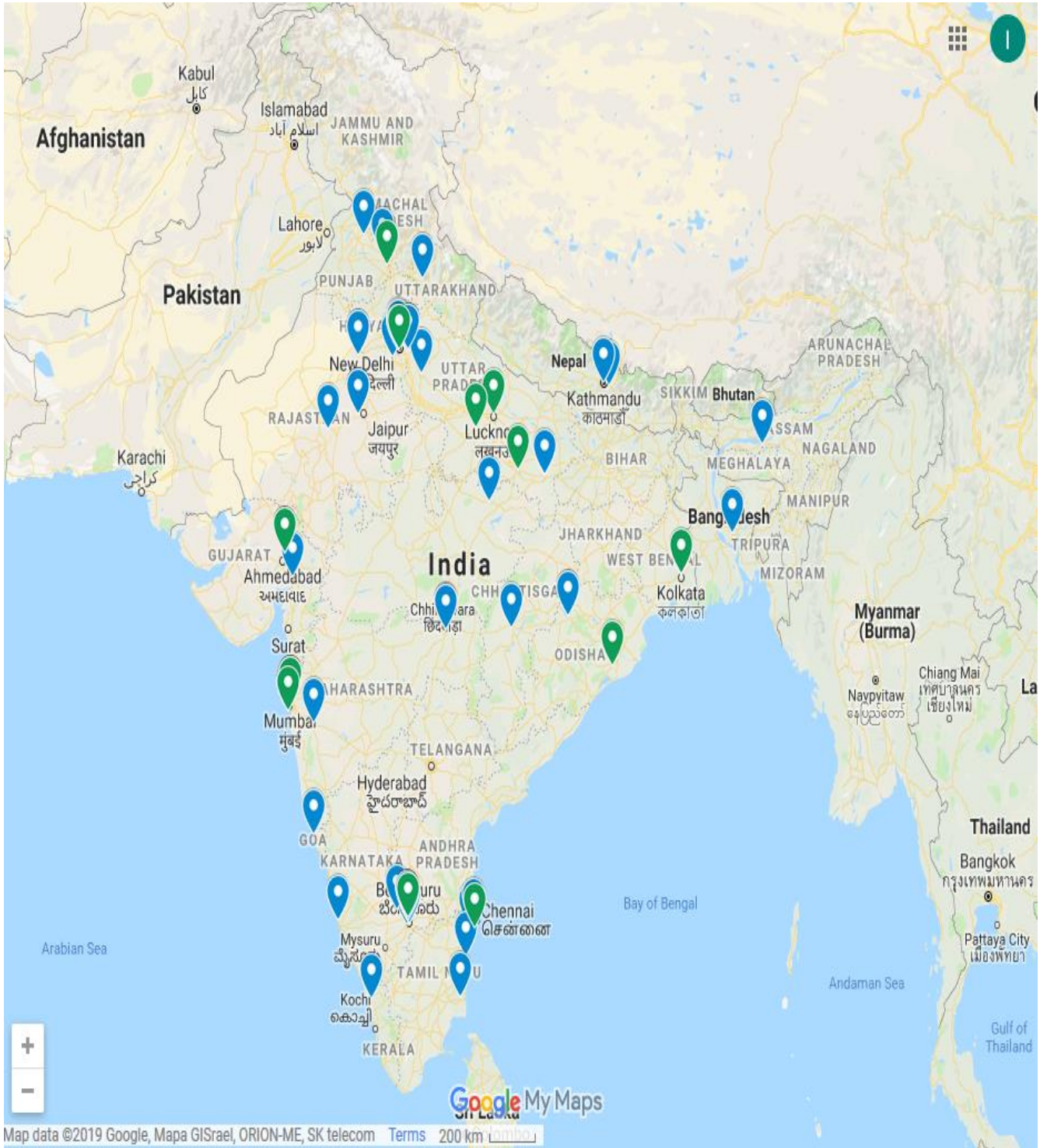
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Geographical Distribution of Conference Attendees

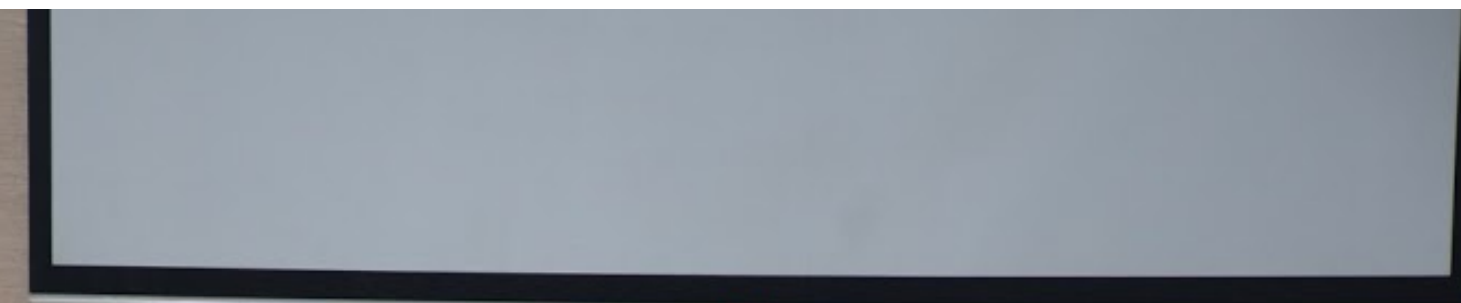


 **Speakers**

 **Participants**



Photographs



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Committee for Women in Mathematics

Indian Women and Mathematics Annual Conference 2019

Venue : Lecture Complex Hall LH 101

10th - 12th June 2019

Thank you for your attention!



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**Indian Women and Mathematics
Annual Conference 2019**

... Hall LH 101

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Committee for
Women in Mathematics

Women and Mathematics
Annual Conference

Lecture Component
10th - 12th June

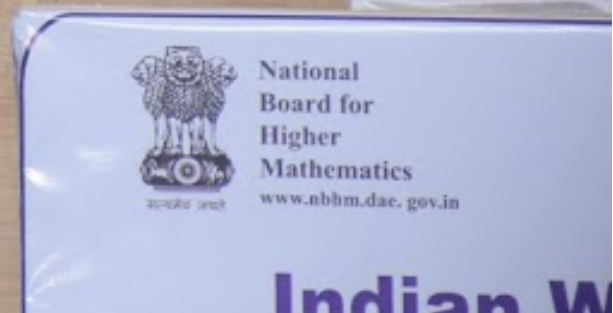












Modular Forms

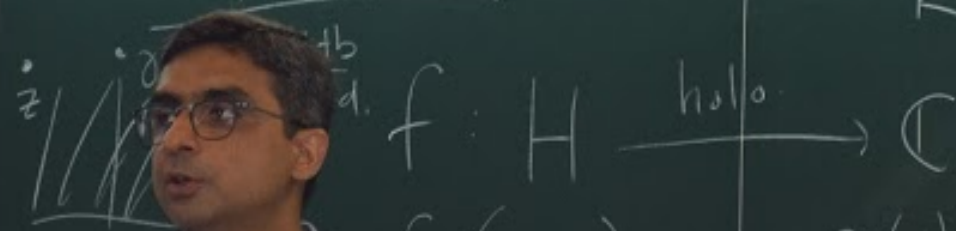
Cusp Forms

$$f \in S_k(N, \chi)$$

$k \geq 2$

$N \geq 1$

χ



$$f(\gamma z) = \chi(d) (cz+d)^k f(z)$$

$\rho_r(N, \chi)$

primitive \rightsquigarrow

$$\rho_f : G_a \rightarrow GL_2(\overline{\mathbb{F}_p})$$

(iv) $\rho_f / G_{\mathbb{F}_p}$

$$\sim \begin{pmatrix} \delta & x \\ 0 & \varepsilon \end{pmatrix}$$

$$\text{Trace}(\rho_f(\text{Frobc})) = a_e$$
$$\det(\rho_f(\text{Frobc})) = f^{k-1} \chi(e)$$

$$= a_e$$
$$= f^{k-1} \chi(e)$$

A decomp

$$G_a(\overline{\mathbb{F}_p}/\mathbb{F}_p)$$

Question 1

(Splitting Question)

When is $x = 0$?





OUTLINE OF THE TALK

- ▶ Introduction
- ▶ Trees with property (P)

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Indian Women and Mathematics Annual Conference 2019

Venue : Lecture Complex Hall LH 101
10th - 12th June 2019

Indian Institute of Technology Bombay
Department of Mathematics
Mumbai, India



Mathematical Calculations
Doc

$2x^2 - 9x + 4 = 0$
 $d = 4, L = 1$
Full form: $2x^2 - 9x + 4 = 0$
 $x = \frac{9 \pm \sqrt{81 - 32}}{4}$
 $x = \frac{9 \pm 7}{4}$
 $x = \frac{16}{4} = 4$
 $x = \frac{2}{4} = \frac{1}{2}$

Indian Women's
Annual Report
Venue: Lecture Hall
Indian Women's
Dept.

Proper Coloring

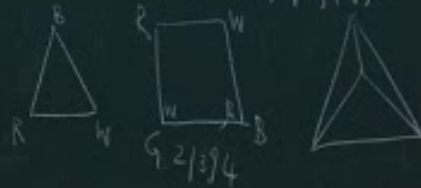
$$G = (V, E)$$

$$(v, w) \in E(G)$$

$$v \rightarrow w$$

$$f: V(G) \rightarrow \{1, \dots, k\} \rightarrow f: V(G) \rightarrow (K, t)$$

$$(v, w) \in E(G) \Rightarrow f(v) \neq f(w)$$



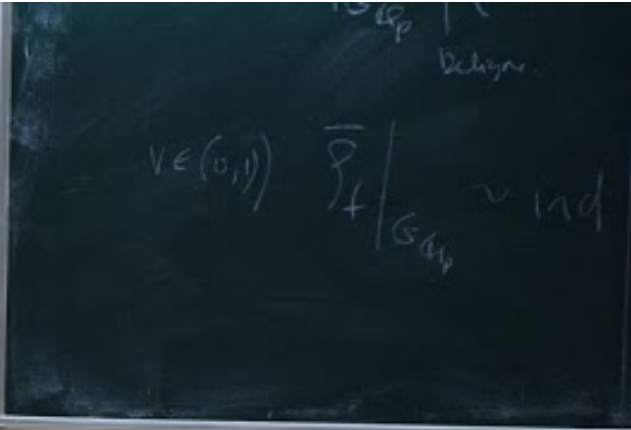
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Lecture Complex Hall LH 1
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$$T_{PM} \times T_{PM} \times T_{PM} \times T_{PM}$$

$$R(x, y, z, w)$$

$$= \left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2} + \frac{\partial^2}{\partial w^2} \right) R(x, y, z, w)$$




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Annual Conference 2019**

Venue : Le...plex Hall LH 1













INDIAN WOMEN AND MATHEMATICS (IWM)

Report of

Regional Workshop on Research and Opportunities

October 19-20, 2019

Department of Mathematics

National Institute of Technology Meghalaya

Shillong, Meghalaya

Supported by

National Board Higher Mathematics

Govt. of India

Summary

The Indian Women and Mathematics (IWM) Regional Workshop on Research and Opportunities was held during October 19-20 at National Institute of Technology Meghalaya, Shillong, Meghalaya. The workshop was aimed at giving exposure to women of North Eastern and Eastern parts of India, engaged in teaching and/or research or pursuing a post-graduate degree in mathematics, to quality research in different areas of mathematics and to various opportunities for pursuing mathematics as a career.

The following committees were constituted for the smooth conduct of the workshop:

| | | | |
|----------------------|---|-------------------|--|
| SCIENTIFIC COMMITTEE | : | Shreemayee Bora, | IIT Guwahati (Convener & IWM Executive Committee member) |
| | | Neela Nataraj, | IIT Bombay (Chairperson, IWM Executive Committee) |
| | | Manideepa Saha, | NIT Meghalaya (Local Organizer) |
| ORGANIZING COMMITTEE | : | Shreemayee Bora, | IIT Guwahati (Convener) |
| | | Manideepa Saha, | NIT Meghalaya (Local Organizer) |
| | | Saikat Mukherjee, | NIT Meghalaya (Local Organizer) |

Inaugural Session

The Chief Guest for the inaugural session was Prof. Bibhuti Bhusan Biswal, Director, NIT Meghalaya and Prof. Ayon Bhattacharjee, Dean(R & C), NIT Meghalaya was invited as Guest of Honour. The session comprised of a welcome by Dr. Manideepa Saha, and was followed by addresses by Prof. Shreemayee Bora, Convener of the workshop, and Prof. Neela Nataraj, Chairperson, IWM Executive Committee, and the Chief Guest. This was followed by the scientific programme of the workshop.

Scientific Program

Six lectures were delivered by six prominent mathematicians. They were from IIT Bombay, IIT Guwahati, IIT Kanpur, IIT Madras, ISI Delhi and from University of Delhi. The duration of each lecture was 45 minutes followed by 5 minutes of discussions. The lectures started with topics accessible to all with a graduate background in mathematics and went on to review recent research in a number of areas of mathematics. They also revealed the interplay between the various areas of mathematics. The participants took keen interest in the discussions on the topics covered. In addition, a 25 minute lecture on 'Opportunities in Mathematics' was also organised to provide information about various opportunities available both in India and abroad for pursuing higher education and research in mathematics, and for the available career opportunities.

Besides the lectures, an interview of Prof. Tanvi Jain (ISI Delhi) was organised. The focus of the interview was her research journey and challenges faced, which was followed by an interaction session with the participants about the difficulties faced them both in research and in their careers.

Furthermore, there were three dedicated poster sessions to display the research work done by the participants. The details of the program schedule are enclosed in Annexure I.

Lectures

The first day comprised of four lectures, whereas there were two lectures on the second day. The details of the lectures are as follows:

Details of lectures on Day 1:

| Sl. No | Name & Affiliation of Speakers | Title of the talk | Abstract |
|--------|--|--|---|
| 1. | Prof. C. S. Lalitha, University of Delhi | Convex optimization and applications | Certain motivating problems in convex set theory such as packing problem, Kepler's conjecture and existence of Gmbc are provided along with certain important properties and concepts related to convex sets. We next consider the notion of convex functions and properties of convex functions to understand the optimality conditions of a convex optimization problem. In this talk we further give a basic algorithm to solve a convex optimization problem followed by applications of convex optimization in medical imaging and facility location problems. |
| 2. | Prof. M. T. Nair, IIT Madras | Lax-Milgram lemma in Banach space setting | Lax-Milgram lemma is one of the basic result in functional analysis which is at the core of theoretical study of PDEs. The classical result is in the setting of Hilbert spaces, and its proof is based on Riesz representation of continuous linear functionals on Hilbert spaces. In this talk we shall consider its generalization in the setting of reflexive Banach spaces, and we shall use Hahn-Banach extension theorem for its proof. The classical result then becomes a special case. |
| 3. | Prof. Sweta Tiwari, IIT Guwahati | Some existence and regularity results on non-local elliptic problems | In this talk, I will discuss some recent developments of elliptical problems involving non-local semilinear and quasilinear operators. Precisely, we consider the following elliptical problem: $(P) \begin{cases} (-\Delta)^s u(x) & \text{or } (-\Delta)_p^s u(x) \\ & u(x) \end{cases} = f(x, u), \quad x \in \Omega, \\ = 0, \quad x \in \mathbb{R}^n \setminus \Omega,$ <p>where Ω is a smooth and bounded domain in \mathbb{R}^n, $n \geq 2$, $s \in (0, 1)$, and $f : \Omega \times \mathbb{R} \rightarrow \mathbb{R}$ is Carathéodory function. We discuss the existence, multiplicity and regularity of the solution of the problem (P) under different growth assumptions on the function $f(x, u)$.</p> |
| 4. | Prof. A. Hariharan, IIT Bombay | Gorenstein Artin rings: A different(ial) point of view | Polynomials and their partial derivatives will be used in this talk to introduce the concept of a Gorenstein Artin local ring. In particular, we look at two specific constructions, namely an idealisation, and a connected sum, from this perspective, and identify a relation between the two constructions. The talk will focus on examples that illustrate the main result, which is a joint work with Jai Laxmi. |

Details of Day 2 lectures:

| Sl. No | Name & Affiliation of Speakers | Title of the talk | Abstract |
|--------|--------------------------------------|------------------------------|--|
| 5. | Prof. Tanvi Jain, ISI Delhi | Entrywise Powers of Matrices | There has been much interest in the study of entrywise products and entrywise functions of matrices that preserve positivity. This study has its roots in the classical works of Schur, Schoenberg and Rudin. It has applications in diverse areas such as statistics, probability and physics. In this talk, we discuss these functions with a special emphasis on the entrywise power functions of matrices. |
| 6. | Prof. Nandini Nilakantan, IIT Kanpur | The Kneser Conjecture | In this talk, we will discuss the celebrated Kneser Conjecture, a problem in graph theory. The proof for this conjecture was provided by Lovasz, who used topological tools in the proof. These tools and a brief outline of the proof will be discussed in this talk. Through this talk, I will try to highlight some of the interplay between topology, graph theory and combinatorics. |

Interaction Session

The interaction session was the final event of the first day. It was scheduled for an hour. The interaction session started with an interview of Prof. Tanvi Jain, ISI Delhi by Prof. Shreemayee Bora. The focus was on her research journey and the challenges faced and how she overcame those on the way to remarkable accomplishments. Prof Jain also took direct questions from the participants at the end of the interview. The session was very well received. It was followed by an interaction session coordinated by Prof Shreemayee Bora and Prof. Neela Natraj with all resource persons addressing the participants' queries and concerns. The session was quite lively with participants opening up on many aspects of their research and teaching careers. One of the main issues raised by the participants was about finding suitable research problems. These and other concerns were nicely addressed by the experts.

Poster Session

A total of 12 posters were presented by the participants. The participants were given the chance to put up the posters from the first tea break of the first day so that they could be viewed during subsequent session breaks and a dedicated poster session was scheduled as the last event of the workshop. The abstracts of the posters are enclosed in Annexure II.

Participants

106 applications were received for participation which included 21 poster presentation applications. Among these, 90 were selected for participation and 16 posters were selected for presentation. The workshop was well attended by 64 (51 Female, 13 Male) registered participants including one foreign female participant from Bangladesh. In addition, there were 8 local attendees from NIT Meghalaya, who didn't register, but attended the workshop. Apart from

these, there were 6 speakers, 4 organizing committee members and few faculty members from NIT Meghalaya. So there were a total of 85 attendees in the workshop. Details of registered participants is enclosed in Annexure III.

Feedback

A feedback form was circulated to all the participants with a request to share their views about the event which could be taken into account when organising future workshops. The format of the feedback form is attached in Annexure IV.

Expenditure

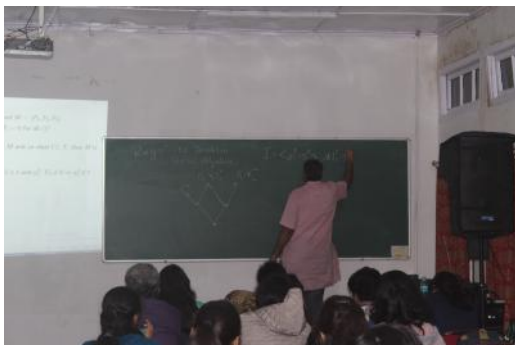
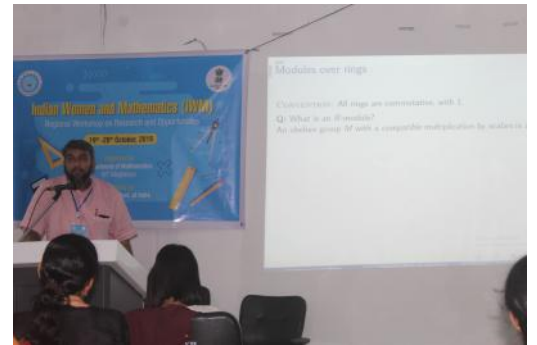
An amount of Rs. 3,99,800/- was released by National Board of Higher Mathematics (NBHM), Govt. of India, for the workshop. Out of this, an amount of Rs.3,98,122/- was spent towards organization of the workshop. A statement of expenditure and an utilization certificate is enclosed in Annexure-V.

Photographs

(a) Photographs of Inaugural Session



(b) Photographs of Lecture Session





(b) Photographs of Poster Session & Breaks



(c) Photographs from Interaction Session:



(d) Group Photographs



ANNEXURE-I

**Indian Women & Mathematics
Regional Workshop on Research and Opportunities
October 19-20, 2019
Dept. of Mathematics, NIT Meghalaya**

Program Schedule

| October 19, 2019 | |
|---|---------------------|
| Programmes | Timing |
| Breakfast & Registration | 8:30 AM – 10 AM |
| Inauguration | 10 AM – 10:30 AM |
| Lecture I: <i>Convex optimization and applications</i> Speaker: C. S. Lalitha | 10:30 AM – 11:20 AM |
| Tea Break / Poster Session | 11:20 AM – 11:50 AM |
| Lecture II: <i>Lax-Milgram lemma in Banach space setting</i> Speaker: M. Thamban Nair | 11:50 AM – 12:40 PM |
| Lunch | 12:40 PM – 2:00 PM |
| Lecture III: <i>Some existence and regularity results on non-local elliptic problems</i> Speaker: Sweta Tiwari | 2:00 PM – 2:50 PM |
| Lecture IV: <i>Gorenstein Artin rings: A different(ial) point of view</i> Speaker: A. Hariharan | 2:50 PM – 3:40 PM |
| Tea Break / Poster Session | 3:40 PM – 4:10 PM |
| Title: <i>Opportunities in mathematics</i> Speaker: Saikat Mukherjee | 4:10 PM – 4:35 PM |
| Interactive Session | 4:35 PM- 5:30 PM |
| Dinner | 7 PM onwards |
| October 20, 2019 | |
| Programmes | Timing |
| Breakfast | 8:00 AM – 9:30 AM |
| Lecture V: <i>Entrywise powers of matrices</i> Speaker: Tanvi Jain | 9:30 AM – 10:20 AM |
| Lecture VI: <i>The Kneser conjecture</i> Speaker: Nandini Nilakantan | 10:20 AM – 11:10 AM |
| Tea Break / Poster Session | 11:10 AM – 12:30 PM |
| Closing | 12:30 PM – 1 PM |
| Lunch | 1 PM – 2 PM |

ANNEXURE II

Poster Details

| Sl No. | Name of the participant | Title of talk | Abstract |
|--------|----------------------------|---|--|
| 1 | Ms. Barbie Chutia | Influence of volume fraction in a mixed convective flow of a dusty fluid over a stretching cylinder with heat source/sink | A steady two-dimensional mixed convective MHD flow of a conducting dusty fluid over a vertical stretching cylinder immersed in a porous medium in the presence of volume fraction and space-time dependent heat source/sink has been investigated using Bvp4c solver. |
| 2 | Ms. Bhagyashree Mahanta | Rheology of Power Law Fluid Flow through Horizontal Porous Medium | A numerical investigation on rheology of power law fluid flow through porous medium has been done. Heat is generated into the system through energy dissipation due to viscosity. Governing Equations are converted into a system of non-linear ordinary differential equations using suitable similarity transformation. These equations are solved numerically using MATLAB built-in bvp4c solver technique. Finally, results are discussed graphically and numerically for various values of flow parameters involved in the solution. |
| 3 | Ms. Parishmita Boruah | Social Interdependence: A new value for TU-Cooperative games | This paper studies cooperative games with restricted cooperation among the players. We analyze situations, where different groups of people, that are involved in different activities and each group's profit is affected by the actions of other groups. Based on players interdependence, we define a new value for TU-cooperative games which reflects players marginal contributions, their status and the height of cooperation with other players in different groups. Further, we characterize our value axiomatically using four new axioms, namely; G-Symmetry, G-Efficiency, G-Linearity and G-Null Player Property. |
| 4 | Ms. Sujata Goala | A Class of Combine Value | In cooperative game theory the Shapley value is the most popular solution concept which is based on player's individual productivity. The Solidarity value is another solution concept based on coalitional productivity and the Equal Division value is based on egalitarian concept. These values are suitable in different real life situations. In their paper, "On convex combination of two values", Nowak and Radzik (1996), combine the Shapley value and the Solidarity value which is a class of new values that consider both individual and group productivity of the players. In this paper we propose a similar class of values that combine the Solidarity value and the Equal Division value and analyse their properties. |
| 5 | Ms. Surashmi Bhattacharyya | Quadratic polynomial approach in eigenvalue problem | The purpose here is to present an efficient numerical technique to find the eigenvalues of multiparameter eigenvalue problem. Here linear element approximation with quadratic polynomial as approximate solution is used to estimate the eigenvalues. A numerical example is given to illustrate the effectiveness of the method. |
| 6 | Ms. Geeti Gogoi | Soret effect on MHD convection flow | This poster investigate the heat and mass transfer of MHD convection flow. The governing equations transform into nonlinear differential equation using similarity transformation and solved numerically by the help of MATLAB bvp4c solver method. The numerical results for velocity, temperature, concentration are presented graphically under the effect of various parameters. |

| | | | |
|----|----------------------------|---|---|
| 7 | Ms. Bandita Phukan | Variable viscosity and thermal conductivity effects on unsteady micropolar fluid flow past a vertical cone with heat generation | A numerical investigation has been carried out on the variable viscosity and thermal conductivity effects on unsteady flow of a micropolar fluid past a vertical cone. The governing partial differential equations of motion are reduced to non-dimensional forms which are discretized using implicit finite difference method of Crank-Nicolson type; then the finite difference equations are solved by an iterative scheme based on Gauss-Seidel method. |
| 8 | Ms. Mamta Kumari | Monotone iterative technique for nonlinear differential equations. | Construction of sequence of functions is a well-known method that approximate with increasing accuracy the solution of a differential equation. This method involves constructing sequences of function $\{u_n\}$ and $\{v_n\}$ that approximate the desired solution of a given differential equation. |
| 9 | Dr. Rehena Nasrin | Heat transfer analysis of hybrid nanofluid flows in enclosure | Hybrid nanofluid is used extensively to enhance heat transfer rate. The present numerical research expects to investigate and compare the performance of hybrid nanofluids (Cu-CNT-water, Cu-CuO-water, Cu-Al ₂ O ₃ - water and Cu-TiO ₂ -water) on mixed convective heat transfer inside a rectangular lid-driven wavy cavity using finite element method of Galerkin's weighted residual technique. |
| 10 | Ms. Binandita Barman | Dynamics of single species under delay dispersal in patchy environment | In this article, we develop models of a single species occupying two distinct patches. The movement (dispersal) of the species is effected by time delay. The model possesses at most one coexisting equilibrium. This feasible equilibrium is globally asymptotically stable. At first, we prove that the time delay does not have any influence in destabilizing the system when both the patches of the non-delayed system are identical. When the patches are heterogeneous in the non-delayed model, instability is experienced for increasing values of time delay. Several types of heterogeneity are discussed by selecting the ecological parameters. It is shown that stability switching does not happen in such patchy models. On the other hand, time delay can have potential to destabilize the system when three patches are identical. |
| 11 | Ms. Pearl Sanchayeta Gogoi | Introduction to the Operator Pseudo Shift | In the branch of operator theory, the weighted shift operators are of fundamental importance, and hence studied quite extensively till date. A similar class of operators are the weighted pseudo shift operators. The scalar weighted pseudo shifts were introduced by Gross-Erdmann in the year 2000. Motivated by these operators, we introduce the class of operator pseudo shifts with a simultaneously diagonalizable sequence of positive invertible operator weights. Further, we show that the operator pseudo shifts are in fact a countable direct sum of unilateral backward shifts, circulant operators and bilateral shifts. |
| 12 | Mr. Sudip Mishra | Stability analysis of cosmological dark energy model. | Einstein field equations are nonlinear differential equations. So it is very hard to find exact solution. We transform the equations to an autonomous system and find the qualitative behavior near critical points. We can find the stability of the motion of the Universe by dynamical system analysis. |

ANNEXURE III

Details of participants

| Sl No. | Name | Affiliation | Category |
|--------|----------------------------|--|---------------------|
| 1 | Ms. Barbie Chutia | Dibrugarh University | Poster Presentation |
| 2 | Ms. Bhagyashree Mahanta | Dibrugarh University | Poster Presentation |
| 3 | Ms. Parishmita Boruah | Dibrugarh University | Poster Presentation |
| 4 | Ms. Sujata Goala | Dibrugarh University | Poster Presentation |
| 5 | Ms. Surashmi Bhattacharyya | Biswanath College of Agriculture, AAU | Poster Presentation |
| 6 | Ms. Geeti Gogoi | Dibrugarh University | Poster Presentation |
| 7 | Ms. Bandita Phukan | Assam Science and Technology University | Poster Presentation |
| 8 | Ms. Mamta Kumari | VVM's Shree Damodar College of Commerce & Economi | Poster Presentation |
| 9 | Dr. Rehena Nasrin | Bangladesh University of Engineering and Technology, Dhaka | Poster Presentation |
| 10 | Mr. Sudip Mishra | Jadavpur University | Poster Presentation |
| 11 | Ms. Binandita Barman | NIT Meghalaya | Poster Presentation |
| 12 | Ms. Pearl Sanchayeta Gogoi | Tezpur University | Poster Presentation |
| 13 | Ms. Madhumita Mahanta | Girijananda Chowdhury Institute Of Management And Technology | Participant |
| 14 | Ms. Bipanchy Buzarbarua | Cotton University | Participant |
| 15 | Ms. Sunayana Saikia | Cotton University | Participant |
| 16 | Ms. Pranami Phukan | NERIST | Participant |
| 17 | Ms. Manjuri Dutta | NERIST | Participant |
| 18 | Ms. Jyoti Saikia | NERIST | Participant |
| 19 | Ms. Ankita Konwar | NERIST | Participant |
| 20 | Ms. Niharika Kakoty | Dibrugarh University | Participant |
| 21 | Ms. Diksha Patwari | Gauhati University | Participant |
| 22 | Ms. Debozani Borgohain | Dibrugarh University | Participant |
| 23 | Ms. Darisha Marbaniang | Assam Don Bosco university | Participant |
| 24 | Ms. Pratima Devi | NERIST | Participant |
| 25 | Ms. Priyanka Kumari | Adamas University | Participant |
| 26 | Ms. Sangita Maity | Adamas University | Participant |
| 27 | Ms. Koushani Roy | Adamas University | Participant |
| 28 | Ms. Amrita De | Adamas University | Participant |
| 29 | Ms. Nyamcha Atta | Assam Don Bosco University | Participant |
| 30 | Mr. Anjan Gautam | SMIT | Participant |
| 31 | Mr. Sagar Saha | IIT Guwahati | Participant |
| 32 | Ms. Bhagyashri Patgiri | NIT Meghalaya | Participant |
| 33 | Ms. Dimpay Mala Dutta | NEHU | Participant |
| 34 | Ms. Marina Chingdeinuam | Assam Don Bosco University | Participant |
| 35 | Ms. Papi Ray | IIT Guwahati | Participant |
| 36 | Ms. Mopi Ado | NERIST | Participant |
| 37 | Ms. Khyodeno Mozhui | IIT Guwahati | Participant |
| 38 | Ms. Vikuozonuo Sekhose | Assam Don Bosco University | Participant |

| | | | |
|----|------------------------------|----------------------------|-------------|
| 39 | Ms. Dovine Dukru | Assam Don Bosco University | Participant |
| 40 | Ms. Shiva Kandpal | IIT Guwahati | Participant |
| 41 | Ms. Khetjing Mounkang | NERIST | Participant |
| 42 | Mr. Champak Talukdar | NEHU | Participant |
| 43 | Mr. Shanborlang Bynnud | NEHU | Participant |
| 44 | Ms. Chinmayee Kumar | Gauhati University | Participant |
| 45 | Mr. Mijanur Rahaman | IIT Guwahati | Participant |
| 46 | Mr. Abhijit Shit | IIT Guwahati | Participant |
| 47 | Mr. Aniruddha Seal | IIT Guwahati | Participant |
| 48 | Mr. Sandip Maji | IIT Guwahati | Participant |
| 49 | Ms. Sabi Biswas | NIT Meghalaya | Participant |
| 50 | Ms. Nilakhi Doley | NIT Meghalaya | Participant |
| 51 | Ms. Pujashree Buragohain | NIT Meghalaya | Participant |
| 52 | Ms. Carefully Marbaniang | NIT Meghalaya | Participant |
| 53 | Ms. Moalila Longkumer | NIT Meghalaya | Participant |
| 54 | Ms. Ibalahun Nongkynrih | NIT Meghalaya | Participant |
| 55 | Ms. Sabari Sarkar Dhar | St. Edmunds College | Participant |
| 56 | Ms. Jharna Kalita | NEHU | Participant |
| 57 | Ms. Ruchika Baruah | NEHU | Participant |
| 58 | Mr. Achint Kumar Mishra | NIT Meghalaya | Participant |
| 59 | Mr. Darshit Goyani | NIT Meghalaya | Participant |
| 60 | Mr. Utkarsh Garg | NIT Meghalaya | Participant |
| 61 | Mr. Sanjiv Subba | NIT Meghalaya | Participant |
| 62 | Dr. Padmini Bhattacharjee | St. Anthony's College | Participant |
| 63 | Ms. Pynhunlang Lynser | St. Anthony's College | Participant |
| 64 | Dr. Asrifa Sultana | IIT Bhilai | Participant |

ANNEXURE IV

Indian Women and Mathematics
Regional Workshop on Research and Opportunities
October 19 & 20, 2019

Department of Mathematics, NIT Meghalaya
(Fully sponsored by the National Board for Higher Mathematics)

Feedback Form

Please tick the appropriate boxes and give additional comments or suggestions in the space provided after each item.

Lectures:

- 1) Was the timings of the lectures appropriate? Yes No

- 2) Were the lectures well presented and organized? Yes No

Interaction Session:

- 1) Was the topic of the interaction session appropriate? Yes No

- 2) Was the interaction session well conducted? Yes No

3) Did you contribute to the discussion in interaction session? Yes No

4) Did you benefit from the discussion in the interaction session?

Supporting facilities:

3) What are your comments about the facilities provided to you?

(i) Accommodation :

(ii) Food:

(iii) Conference facilities:

4) Did the programme fulfill your expectations and was it useful in achieving your objectives? Yes No

5) Any other comments or suggestions:

Report of IWM Winter School for Young Women at IISER Thiruvananthapuram

Venue: Indian Institute of Science Education and Research Thiruvananthapuram

Dates: December 16 - 21, 2019

The Executive Committee Members of IWM:

- Amber HABIB, Shiv Nadar University
- Anita NAOLEKAR, ISI Bangalore
- Anisa CHORWADWALA, IISER Pune
- B. Sri PADMAVATI, University of Hyderabad
- Gautam BHARALI, IISc
- Geetha VENKATARAMAN, Ambedkar University 
- Mahuya DATTA, ISI Kolkata
- Neela NATARAJ, IIT Bombay (Chairperson)
- Nikita AGARWAL, IISER Bhopal
- Pooja SINGLA, IISc
- Riddhi SHAH, JNU
- Sachi SRIVASTAVA, University of Delhi
- Shreemayee BORA, IIT Guwahati
- Vijaylaxmi TRIVEDI, TIFR 

The Scientific Committee for the Workshop at IISER TVM

- Mahuya DATTA, ISI Kolkata
- Sheetal DHARMATTI, IISER Thiruvananthapuram
- Anita NAOLEKAR, ISI Bangalore
- Neela NATARAJ, IIT Bombay
- Riddhi SHAH, JNU

Organizing Committee for the Workshop at IISER TVM

- Sheetal DHARMATTI, IISER TVM
- Srilakshmi KRISHNAMOORTHY, IISER TVM
- Anita NAOLEKAR, ISI Bangalore
- Shrihari SRIDHARAN, IISER TVM
- Geetha THANGAVELU, IISER TVM

Goal of the Workshop: To give young students broader exposure to reasoning through logical steps to achieve critical mathematical thinking and problem solving skills.

Eligibility: Students pursuing second year BA/ BSc/ Integrated MSc or any equivalent degree and having mathematics as one of the major subjects during the academic year 2019-20

Funding:

- The workshop was funded by NBHM and partially by IISER Thiruvananthapuram
- The funding for this program was sought for 40 outstation and 15 local participants by IWM to NBHM. The program was approved to accommodate 40 outstation and 10 local participants by NBHM.
- With the encouragement and financial support from IISER Thiruvananthapuram in terms of providing food and accommodation to the students at reduced rates, the program was redesigned to host 80 outstation and 20 local participants.

Selection Procedure:

- To publicise and to invite online applications for the program a website was hosted at IISER Thiruvananthapuram webpage namely: <http://workshop.iisertvm.ac.in/womeninmath.2019/>.
- The program was widely publicised via emails
- Posters were printed and sent to 50 colleges and institutions in the states of Andhra Pradesh, Goa, Karnataka, Kerala, Maharashtra, Puducherry, Tamil Nadu and Telangana.
- Paper applications were also accepted from students.

A total of 747 applications were received that include 689 online applications and 23 postal applications from various colleges and institutes spread across the states of Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Telangana; 35 online applications from IISER-TVM students.

The applicants' scoresheet, in particular their scores in the Mathematics courses in the first year of the programme that each applicant is enrolled in, became the primary parameter for selection. Further, the selection criteria also took care to give adequate representation to the geographical spread of the focused area of the programme.

Based on these criteria, a total of 83 candidates from 689, 3 candidates from 23 and 25 candidates from 35 were selected for participation in the programme and were asked to confirm their participation by sending an email within November 8, 2019. Also 15 more students were waitlisted, in case a vacancy arose due to non-confirmation of any of these selected students. The waitlist was activated on November 9, 2019 and the students were asked to confirm their participation by November 16, 2019.

A total of 95 (73 outstation and 22 IISER) students participated in the programme. The poster of the workshop is attached as annexure 1 and the list of participants is attached in annexure 2.

Details of the Academic Activities:

Resource persons and Topics Covered:

- Moosath K SUBRAHAMANIAN, IIST Thiruvananthapuram (Real Analysis)
- Anita NAOLEKAR, ISI Bangalore (Linear Algebra)
- Dhanya RAJENDRAN, IIT Goa (Ordinary Differential Equations)
- Pooja SINGLA, IISc Bangalore (Linear Algebra)

Course and Program Structure:

- Each resource person gave three 1.5 hour lectures on the topics assigned to them. Apart from lectures they supervised two tutorial sessions each.
- From the second day onwards, everyday, a 30 minutes discussion session was conducted before starting the day's lecture session. The students' doubts were cleared in this session and small quiz/ tests were given to students.
- Everyday Tutorials were conducted by PhD students of IISER Thiruvananthapuram. In all TWELVE (three for each Topic) PhD students were involved in conducting these sessions. They solved the assignments given by the instructors and also encouraged students to solve the assignment problems on their own, in the group and also sometimes on the board. One lab session where tutor demonstrated solving ODE numerically was included to give students flavour of computational mathematics.
- Moreover, everyday after dinner problem solving session was conducted. These were informal sessions where students got the chance to talk and discuss with each other and also with the tutors and faculties who were present. Students were enthusiastic about this activity as they could clarify their doubts at their own pace.
- Apart from this THREE special lectures on general topics of mathematics were conducted.
- The detailed schedule of the workshop is attached as annexure 3.

Details of the Topics covered in the lectures is as follows:

Real Analysis:

Detailed description of a complete ordered field F is given and certain basic results were proved using the axioms. Then it was shown that the characteristic of F is zero and identified Z as a subset of F and Q as the smallest subfield containing the additive identity and multiplicative identity. Then the Archimedean property is proved. A brief idea of the construction of real numbers R is given and the structure of R as the complete ordered field is made clear. A dense subset in a complete ordered field is defined and proved that Q is dense in R . Sequence of real numbers, convergence of a sequence and various properties of converging sequences, monotone sequences and convergence were covered. Then subsequences and certain basic results were discussed.

Linear Algebra:

Part-I: In this part, the following topics were covered: Solving a system of linear equations using matrices, row reduced Echelon forms, invertible matrices and equivalent conditions for matrix to be invertible. Computation of row space, null space and column space of matrices, their bases. Eigenvalues, eigenvectors, diagonalizability of matrices.

Part-II: This part was developed on the first part. The following topics were discussed: Vector spaces, Linear transformations, Correspondence between matrices and linear transformation, Change of basis, Rank nullity Theorem, Cayley-Hamilton Theorem, An application of Linear algebra towards page rank algorithm.

ODE

First order differential equations, Variable Separable method, Fundamental theorem of Calculus, Exact equations were discussed on the first day. On the second day Lipschitz continuous functions and idea behind Picard's theorem was discussed in detail. In the lab session the Ph.D students explained the Euler method and solved some nonlinear equations using Matlab. Some aspects of well-posedness of differential equations and its physical significance were also mentioned. Last lecture was devoted to the linear dependence and independence of functions and towards solving constant coefficient second order linear differential equation.

Special Lecture 1 :

The first special lecture was given by IWM chairperson Prof. Neela Nataraj on the first day of the workshop. The topic of her lecture was A short introduction to Finite Element Methods. In this talk, starting from a simple second order boundary value problem, definition of weak formulation and finite dimensional problem definition that is linear matrix equation was developed. The convergence of finite dimensional solutions to the solution of actual problem was mentioned. Thus the talk presented a connection between ODE, Linear Algebra and analysis techniques emphasizing the importance of all the three topics using a simple example.

Special Lecture 2:

The second lecture was given by Dr. Geetha Thangavelu of IISER Thiruvananthapuram, titled "Symmetries and Groups". In this lecture, the students were introduced with different symmetries say the rotational symmetries and the mirror reflection symmetries on polygons and non-polygonal shapes. In this lecture, various properties of binary operation was explained and the idea of groups was introduced to them as a link between the above two and as a mathematical study that explores general ways of studying symmetries. Finally, the lecture ended with introducing to the students dihedral groups (resp. cyclic groups) arising as the group (resp. subgroups) of symmetries of regular polygons and emphasized the importance of group theory in contemporary mathematics.

Special Lecture 3:

The third special lecture was given by Dr. Sheetal Dharmatti of IISER Thiruvananthapuram. It was shown that there exists a nowhere differentiable but everywhere continuous function from real numbers to itself. A basic construction of Weierstrass' function was shown. The continuity of function was obtained using the theorem: uniform limit of series of continuous functions is continuous. Further using simple calculus techniques it was proved that function is not differentiable at any point in real numbers.

Follow Up Program

- Looking at the response of the students, it is envisaged that the follow up program of similar type be conducted in December 2020, comprising women students pursuing mathematics in their third year of undergraduate studies. This follow-up might give them the required boost, mathematically and morally, to get into a good MSc programme in the country.
- The main idea is to identify a few bright students amongst the participants and train them further so that they will be encouraged to choose mathematics and mathematics research as a career option.
- Accordingly, on the last day of the program, students were given a small test (one problem on each topic). The answer sheets were corrected by tutors and were distributed back. A list of 30-35 students from the participants is shortlisted who seem to be bright, hard working and can be further trained.

Annexures:

1. Poster of the Workshop
2. List of Participants
3. Schedule of the Workshop
4. Photos
5. Few experts of Feedback forms





WINTER SCHOOL IN MATHEMATICS FOR YOUNG WOMEN



Indian Women and Mathematics (IWM) is a collective of Indian mathematicians that has been in existence since 2009. The objective of IWM is to encourage more women to pursue higher education in Mathematics and to organise events and networking opportunities that will enable them to take up careers in Mathematics. For more details about IWM, please visit <https://sites.google.com/site/iwmmath>

IWM in association with **Indian Institute of Science Education and Research Thiruvananthapuram (IISER-TVM)** is organising a winter school in December 2019. This is a one week programme intended to benefit students studying in second year BA/B-Sc/Integrated MSc or any other equivalent degree and having Mathematics as one of the major subjects/courses, during the academic year 2019-20. The programme will however, have a special focus on women participants. The aim is to encourage and support large scale participation of women.

In a period of one week, this programme shall aim to provide young students a broader exposure to reasoning through logical steps to achieve critical mathematical thinking, apart from problem solving skills in the areas specified.

The winter school will be funded by the **National Board for Higher Mathematics (NBHM), Department of Atomic Energy (DAE), Government of India.**

Topics Covered

Linear Algebra, Ordinary Differential Equations, Real Analysis.

Resource Persons

1. Subrahmanian Moosath K.S **IIST Trivandrum**
2. Anita Naolekar **ISI Bangalore**
3. Dhanya Rajendran **IIT Goa**
4. Pooja Singla **IISc Bangalore**

Eligibility

All applicants should be enrolled in second year BA/BSc/Integrated MSc or any other equivalent degree and having Mathematics as one of the major subjects/courses, during the academic year 2019-20.

Local students, regardless of gender and outstation women students are eligible to apply.

Application

All applicants are requested to visit the programme webpage to fill the online application form.

<http://workshop.iisertvm.ac.in/womeninmath.2019>

Women students from Andhra Pradesh, Goa, Karnataka, Kerala, Maharashtra, Puducherry, Tamil Nadu and Telangana are encouraged to apply.

Support

Travel support (upto III AC train fare) and local hospitality will be provided to all selected outstation women participants.

Scientific Committee

1. Mahuya Datta **ISI Kolkata**
2. Sheetal Dharmatti **IISER TVM**
3. Anita Naolekar (IWM EC Member) **ISI Bangalore**
4. Neela Nataraj (IWM Chair) **IIT Bombay**
5. Riddhi Shah (IWM EC Member) **JNU Delhi**

Organizing Committee

1. Sheetal Dharmatti **IISER TVM**
2. Srilakshmi Krishnamoorthy **IISER TVM**
3. Anita Naolekar **ISI Bangalore**
4. Shrihari Sridharan **IISER TVM**
5. Geetha Thangavelu **IISER TVM**

Deadline for submitting applications: 15 Oct, 2019

<http://workshop.iisertvm.ac.in/womeninmath.2019>

womeninmath.2019@iisertvm.ac.in

Indian Institute of Science Education and Research Thiruvananthapuram
Maruthamala PO, Vithura 695551. Kerala, India.

List of Participants

| | IWM Registration | Name |
|------------|------------------|--|
| Serial No. | Application No. | Name |
| 1 | WIM190003 | SANTRA JOHNY |
| 2 | WIM190018 | AARTHI SANKAR |
| 3 | WIM190039 | DISHA BHATTACHARJEE |
| 4 | WIM190042 | AISHWARYA S |
| 5 | WIM190045 | DARSHNE S M |
| 6 | WIM190066 | JANHAVEE THAKUR |
| 7 | WIM190069 | ELIZABETH JOICE |
| 8 | WIM190074 | AFREEN KANSAL |
| 9 | WIM190076 | SREENITHA V |
| 10 | WIM190097 | DINNY ANN DANIEL |
| 11 | WIM190105 | SUBHA SHREE R |
| 12 | WIM190116 | BHAGYASHRI K N |
| 13 | WIM190118 | ANAKHA A MENON |
| 14 | WIM190119 | MRUNALI JADHAV |
| 15 | WIM190123 | NIVEDITHA K V |
| 16 | WIM190128 | DEVIKA SANTHOSH |
| 17 | WIM190132 | ANU D |
| 18 | WIM190133 | KRIPPA NANDHINI |
| 19 | WIM190140 | NIVEDITHA SIDDARAM |
| 20 | WIM190171 | SWATHI B |
| 21 | WIM190175 | PARVATHY KRISHNA |
| 22 | WIM190178 | RITU MAREBAL |
| 23 | WIM190183 | SIDDANNA VASAVI SRI SAI RATNA JAGADISWARI |
| 24 | WIM190186 | SUMA S |
| 25 | WIM190187 | VILASINI ASHOKAN |
| 26 | WIM190195 | JAYSHREE CHAVAN |
| 27 | WIM190213 | SOWMITHRA CHINNASAMY |

| | | |
|----|-----------|--------------------------|
| 28 | WIM190225 | VISISHTA RAO MANTRALA |
| 29 | WIM190226 | SREELAKSHMI SUNIL |
| 30 | WIM190233 | SRUSHTI PATIL |
| 31 | WIM190243 | SRINIDI V |
| 32 | WIM190324 | ALVINA BIJI |
| 33 | WIM190326 | RUCHI KULKARNI |
| 34 | WIM190338 | ALLU MARIYAM MATHEWS |
| 35 | WIM190350 | HASEEBA NASREEN P |
| 36 | WIM190372 | RUTUJA KALE |
| 37 | WIM190380 | INDHUMATHI K |
| 38 | WIM190384 | PLEEZENT BRASS |
| 39 | WIM190385 | ATHULYA SUNIL |
| 40 | WIM190391 | GARGI PATIL |
| 41 | WIM190397 | AAKANKSHA DIXIT |
| 42 | WIM190421 | DEEPIKA P |
| 43 | WIM190426 | NAJA THASNIM NJARAKKODAN |
| 44 | WIM190438 | EMILIN SHAJI |
| 45 | WIM190448 | VANMATHI M MATHI |
| 46 | WIM190449 | POOJA DHARSNEE.G.R |
| 47 | WIM190528 | NASLA M |
| 48 | WIM190537 | S DEVIPRIYA |
| 49 | WIM190543 | ALEXEENA BIJU |
| 50 | WIM190555 | GOPIKA N NAIR |
| 51 | WIM190556 | MEGHA MADHUSUDHAN |
| 52 | WIM190559 | MOHAMMED SHAMEEM |
| 53 | WIM190561 | MUHAMMED SAHEER MADATHIL |
| 54 | WIM190565 | SOUMYA ACHAMMA THOMAS |
| 55 | WIM190581 | NOORA MUBASHIRA P |
| 56 | WIM190589 | RAGINI CHOURASIA |
| 57 | WIM190596 | ARATHI DAS |
| 58 | WIM190600 | SAGA P S |

| | | |
|----|----------------|---------------------------|
| 59 | WIM190603 | CHAHANA N |
| 60 | WIM190604 | GOKUL N |
| 61 | WIM190606 | PARVATHY RAVINDRANATH |
| 62 | WIM190617 | SHANMUGA MARI.B |
| 63 | WIM190619 | DAVID PETER |
| 64 | WIM190624 | SAMEER E |
| 65 | WIM190631 | PREETHIMA G |
| 66 | WIM190672 | NANDANA SURESH |
| 67 | WIM190677 | SREELAKSHMI MURALEEDHARAN |
| 68 | WIM190678 | NAYANA M S |
| 69 | WIM190685 | SHIVANI CHINTAKUNTALWAR |
| 70 | WIM190687 | SEJAL JAIN |
| 71 | WIM190707 | SRUTHI K S |
| 72 | PostalC1 | JANANI SEKAR |
| 73 | PostalC2 | SREELAKSHMI |
| | IISER Students | |
| 1 | IMS180001 | Aaptha Saroja |
| 2 | IMS18002 | Abhijith S |
| 3 | IMS18011 | Akshay P |
| 4 | IMS18012 | Aksshay N R |
| 5 | IMS18205 | Sam K Mathew |
| 6 | IMS18018 | Amrutha Rajan |
| 7 | IMS18019 | Anagha Rajeev |
| 8 | IMS18020 | Anagha U P |
| 9 | IMS18030 | Anupama Babulal |
| 10 | IMS18033 | Aravind Rajeev S |
| 11 | IMS18048 | Devadevan M M |
| 12 | IMS18062 | M Haritha |
| 13 | IMS18071 | Jibin N Sunil |
| 14 | IMS18085 | Maanav Srihari |
| 15 | IMS18087 | Megha Dinesh |

| | | |
|----|----------|--------------------|
| 16 | IMS18088 | Midhun Murali |
| 17 | IMS18090 | Mohammed Shafi |
| 18 | IMS18095 | Navaneetha E P |
| 19 | IMS18112 | S Akshaya Sidharth |
| 20 | IMS18117 | Sanah |
| 21 | IMS18173 | Amulya V Hejjaji |
| 22 | IMS18176 | Greeshma LS |
| | | |

| <p style="text-align: center;">Winter School in Mathematics for Young Women Thiruvananthapuram, December 2019 Venue: Physical Science Buliding (PSE) Seminar Hall, Room No. 3201</p> | | | | | | | | |
|--|--|--------------|---------------|--------------|-------------|--------------------------------|-------------|-----------------------------|
| | 9.00 - 9.30 | 9.30 - 11.00 | 11.00 - 11.30 | 11.30 - 1.00 | 1.00 - 2.30 | 2.30 - 4.00 | 4.00 - 4.30 | 4.30 - 5.30 |
| Monday 16 | Inauguration 8.30 to 9.00 am Registration 9.00 to 9.30 am | LA Anita | Tea Break | RA | Lunch | Tutorial (RA) | Tea Break | SL-I |
| Tuesday 17 | Discussion | LA Anita | | ODE | | Tutorial (LA) | | Tutorial (ODE) |
| Wednesday 18 | Discussion | ODE | | LA Anita | | Tutorial (LA) | | SL-II |
| Thursday 19 | Discussion | RA | | LA Pooja | | Tutorial (RA) | | LAB (upto 6.00) |
| Friday 20 | Discussion | LA Pooja | | RA | | Tutorial (LA) | | SL-III |
| Saturday 21 | Discussion | ODE | | LA Pooja | | Tutorial (LA) (2.30 - 3.30) | | Valedictory (4.00 -4.30) |

LA - Linear Algebra

ODE - Ordinary Differential Equations

RA - Real Analysis

SL - Special Lecture





Email feedback from a participant:

----- Forwarded message -----

From: **S Devipriya** <sdevipriya1999@gmail.com>

Date: Sat, Dec 21, 2019 at 8:16 PM

Subject: A letter of thanks!

To: Indian Women in Mathematics <womeninmath.2019@iisertvm.ac.in>

Dear Ma'am,

I am Devipriya and I have found this week to be extremely fruitful. I really wanted to thank all of you for your efforts.

Personally, I am yet to have any course on RA, LA or ODE. Although I very much love mathematics, I always feel my mathematics is poor ever since I started my IMSc. Possibly because our physics professors expect us to work out most of math and lacking the necessary mathematics courses, it had been difficult. I have been trying to learn LA on my own for Quantum Mechanics, but with this work shop I feel much more guided and motivated in doing that. I am very grateful, especially to Dr. Anita and Dr. Pooja.

I have also noticed the workshop hand-picked mostly students from local colleges, and I strongly believe workshops like these do mean a lot to us. For some of my friends I made here, it's like a window to a larger world beyond that they have never explored before. Infact I met a lot of students who have no idea of institutes like CMI, or even IISc. Indeed this workshop does make a lot of difference to many.

My only complaint is the short time frame which necessitates squeezing so much into that time frame. But I really do understand it's inevitable, although maybe something can be done about that in future workshops.

On a different note, interacting with you, Dr. Pooja, Dr. Anitha, Dr. Geetha, Dr. Dhanya and Dr. Neela gives a wonderful feeling about pursuing a research career. We always doubt what we can do but when young girls in Science see women who are there doing research work at national institutes, managing their work and home life efficiently : there certainly cannot be a greater motivation for us than that! In that respect, I feel IWM accomplishes it's goal perfectly.

All in all this workshop had been a memorable experience for me. Thanks a lot for this valuable opportunity for learning and interacting with you and other professors.

Thanks a lot again ma'am!

Yours sincerely,
S Devipriya