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Name: **Dr. LALIT KUMAR**

Current Position: **Professor**

Department of Mathematics,

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Qualification: **Ph. D. (Mathematics), University of Delhi.**

Research Interests

- Functional Analysis.
- Frame Theory.
- Wavelet Analysis.

Research Publications

- (1) Sums of frames from the Weyl-Heisenberg group and applications to frame algorithm, [arXiv preprint](#), arXiv: 2306.09493. (with Divya Jindal and Jyoti).
- (2) Nonstationary frames of translates and frames for the Weyl-Heisenberg group and the extended affine group, *Journal of Physics A: Mathematical and Theoretical*, to appear. (with Divya Jindal).
- (3) Matrix-valued Gabor frames over LCA Groups for Operators, *Filomat*, **37** (28) (2023), to appear. (with Jyoti and U.K. Sinha).
- (4) On Hilbert-Schmidt frames for operators and Riesz bases, *Journal of Mathematical Physics, Analysis, Geometry*, **19** (3) (2023), to appear. (with Jyoti).
- (5) Frames with several generators associated with Weyl-Heisenberg group and extended affine group, *Bulletin of the Malaysian Mathematical Sciences Society*, **45** (5) (2022), 2413-2430. (with Divya Jindal). **MR4489569, Zbl07596053.**
- (6) Duality for matrix-valued wave packet frames in $L^2(\mathbb{R}^n, \mathbb{C}^{s \times r})$, *International Journal of Wavelets Multiresolution and Information Process*, **20** (4) (2022), Paper No. 2250007, 20 pp. (with Jyoti). **MR4458453, Zbl1504.42088.** (with Jyoti).
- (7) On vector-valued nonuniform multiresolution analysis, *Applicable Analysis*, **101** (17) (2022), 6013-6027. (with H.K. Malhotra). **MR4486470, Zbl07594752.**
- (8) Discrete vector-valued nonuniform Gabor frames, *Bulletin des Sciences Mathématiques*, **178** (2022), Art. No. 103145, pp. 34. (with H.K. Malhotra). **MR4428742, Zbl 1491.42047.**
- (9) Construction of P^{th} -stage nonuniform discrete wavelet frames, *Results in Mathematics*, **76** (3) (2021), Art. No. 1427, 30 pp. (with H.K. Malhotra). **MR4261749, Zbl 1467.42048.**
- (10) Unitary extension principle for nonuniform wavelet frames in $L^2(\mathbb{R})$, *Journal of Mathematical Physics, Analysis, Geometry*, **17** (1) (2021), 79–94. (with H.K. Malhotra). **MR4263894, Zbl 07406967.**

- (11) On matrix-valued wave packet frames in $L^2(\mathbb{R}^d, \mathbb{C}^{s \times r})$, *Analysis and Mathematical Physics*, **10** (4) (2020), Art 66, 24 pp. (with Jyoti) **MR4169373**, **Zbl 1455.42029**.
- (12) On scaling functions of nonuniform multiresolution analysis in $L^2(\mathbb{R})$, *International Journal of Wavelets Multiresolution and Information Process*, **18** (2) (2020), 1950055, 14pp. (with H.K. Malhotra). **MR4079091**, **Zbl 1442.42079**.
- (13) Operators related to the reconstruction property in Banach spaces, *Results in Mathematics*, **74** (3) (2019), Art 125, 17 pp. (with Jyoti and G. Verma). **MR3958787**, **Zbl 1419.42027**.
- (14) On excess of retro Banach frames, *Izvestiya Natsional'naya Akademiya Nauk Armenii Matematika*, **54** (3) (2019), 87–92; translation in *Journal of Contemporary Mathematical Analysis*, **54** (3) (2019), 129–132. **MR3979969**, **Zbl 1437.42051**. (with G. Verma and M. Singh).
- (15) Vector-valued (Super) weaving frames, *Journal of Geometry and Physics*, **134** (2018), 48–57. (with Deepshikha). **MR3886925**, **Zbl 1403.42036**.
- (16) \mathcal{K} -Matrix-valued wave packet frames in $L^2(\mathbb{R}^d, \mathbb{C}^{s \times r})$, *Mathematical Physics, Analysis and Geometry*, **21** (3) (2018), Art 21, 19 pp. (with Jyoti). **MR3835627**, **Zbl 1396.41020**.
- (17) On weaving frames, *Houston Journal of Mathematics*, **44** (3) (2018), 887–915. (with Deepshikha). **MR3879982**, **Zbl 1412.42075**.
- (18) On generalized weaving frames in Hilbert spaces, *Rocky Mountain Journal of Mathematics*, **48** (2) (2018), 661–685. (with Deepshikha, S. Garg and P. K. Das). **MR3810464**, **Zbl 1392.42030**.
- (19) Sums of Matrix-Valued Wave Packet Frames in $L^2(\mathbb{R}^d, \mathbb{C}^{s \times r})$, *Glasnik Matematički Ser. III*, **53** (1) (2018), 153–177. (with Jyoti, Deepshikha and G. Verma). **MR3814235**, **Zbl 06912626**.
- (20) Weaving K -frames in Hilbert spaces, *Results in Mathematics*, **73** (2)(2018), Art 81, 20 pp. (with Deepshikha). **MR3805557**, **Zbl 1407.42022**.
- (21) On WH-packets of matrix-valued wave packet frames in $L^2(\mathbb{R}^n, \mathbb{C}^{s \times r})$, *International Journal of Wavelets Multiresolution and Information Process*, **16** (3) (2018), 1850022, 22 pp. (with Jyoti). **MR3805708**, **Zbl 1396.42008**.
- (22) Generalized weaving frames for operators in Hilbert spaces, *Results in Mathematics*, **72** (3) (2017), 1360–1391. (with Deepshikha and G. Verma) **MR3721620**, **Zbl 1385.42028**.
- (23) Frames in topological algebras, *Politehn. Univ. Bucharest Sci. Bull. Ser. A Appl. Math. Phys.*, **79** (3) (2017), 163–170. (with Saakshi Garg). **MR3703289**.
- (24) Necessary and sufficient conditions for discrete wavelet frames in \mathbb{C}^N , *Journal of Geometry and Physics*, **117** (2017), 134–143. (with Deepshikha) **MR3645837**, **Zbl 1364.42035**.
- (25) On continuous weaving frames, *Advances in Pure and Applied Mathematics*, **8** (1) (2017), 15–31. (with Deepshikha) **MR3592583**, **Zbl 1365.42028**.
- (26) Traces of Hadamard and Kronecker products of matrices, *Mathematics for Applications (Brno)*, **6** (2017) 143–150 (with P. K. Das). **MR3742414**, **Zbl 1386.15042**.
- (27) Extension of Bessel sequences to dual frames in Hilbert spaces, *Politehn. Univ. Bucharest Sci. Bull. Ser. A Appl. Math. Phys.*, **79** (2) (2017), 71–82. (with Deepshikha). **MR3678067**.
- (28) Weaving K -fusion frames in Hilbert spaces, *Ganita*, **67** (1) (2017), 41–52. (with Saakshi Garg) **MR3785319**.

- (29) Weaving properties of generalized continuous frames generated by an iterated function system, *Journal of Geometry and Physics*, **110** (2016), 282–295. (with Deepshikha) **MR3566116**, **Zbl 1417.42038**.
- (30) On perturbation of frames in locally convex spaces, *Jordan Journal of Mathematics and Statistics*, **9** (4) (2016), 271–286. (with S. Garg and G. Khattar) **MR3603193**, **Zbl 1362.42068**.
- (31) Extension of Weyl-Heisenberg wave packet Bessel sequences to dual frames in $L^2(\mathbb{R})$, *Journal of Classical Analysis*, **8** (2) (2016), 131–145. (with Deepshikha) **MR3535232**.
- (32) A note on discrete frames of translates in \mathbb{C}^N , *TWMS Journal of Applied and Engineering Mathematics*, **6** (1) (2016), 143–149. (with Deepshikha) **MR3594863**, **Zbl 1371.42038**.
- (33) Error locating codes by using blockwise-tensor product of blockwise detecting / correcting codes, *Khayyam Journal of Mathematics*, **2** (1) (2016), 6–17. (with P. K. Das) **MR3577213**, **Zbl 1380.94144**.
- (34) On exact frames in topological algebras, *Palestine Journal of Mathematics*, **5** (1) (2016), 131–134 (with Saakshi Garg)
- (35) On perturbation of binary linear codes, *Mathematics for Applications (Brno)*, **4** (2) (2015), 91–99. (with P. K. Das) **MR3437508** **Zbl 1370.94573**.
- (36) Shadow of operators on frames, *TWMS Journal of Applied and Engineering Mathematics*, **5** (1) (2015), 132–144. (with R. Chugh and M. Singh) **MR3357161**, **Zbl 1328.42007**.
- (37) Irregular Weyl-Heisenberg wave packet frames in $L^2(\mathbb{R})$, *Bulletin des Sciences Mathematiques*, **139** (1) (2015), 61–74. (with A. K. Sah). **MR3312288**, **Zbl 1307.42031**.
- (38) Banach frames generated by compact operators associated with a boundary value problem, *TWMS Journal of Pure and Applied Mathematics*, **6** (2) (2015), 254–258. **MR3689356**, **Zbl 1348.42041**.
- (39) Some types of convergence related to the reconstruction property in Banach spaces, *Banach Journal of Mathematical Analysis*, **9** (2) (2014), 253–275. (with G. Khattar) **MR3296117**, **Zbl 1311.42082**.
- (40) The reconstruction property in Banach spaces generated by matrices, *Advances in Pure and Applied Mathematics*, **5** (3) (2014), 151–160. (with G. Khattar). **MR3259018**, **Zbl 1297.42044**
- (41) Frames of eigenfunctions associated with a boundary value problem, *International Journal of Analysis*, Vol. 2014, Article ID 590324, 6 pages, 2014. doi:10.1155/2014/590324. **MR3219410**(with Shalu Sharma).
- (42) Reconstruction property and frames in Banach spaces, *Palestine Journal of Mathematics*, **3**(1) (2014), 11–26. (with S. K. Kaushik and G. Khattar). **MR3109934** **Zbl 1389.42064**.
- (43) Some results concerning frames associated with measurable spaces, *TWMS Journal of Pure and Applied Mathematics*, **4** (1) (2013), 52–60. (with S.K.Kaushik and S.K.Sharma). **MR3097680**, **Zbl 1312.42034**.
- (44) On \mathcal{J} -reconstruction property, *Advances in Pure Mathematics*, **3** (3) (2013), 324–330. (with G. Khattar).
- (45) On Φ -Schauder frames, *TWMS Journal of Applied and Engineering Mathematics*, **2** (1) (2012), 116–120. **MR3068866**, **Zbl 1274.42080**.

- (46) On retro Banach frames of type P , *Azerbaijan Journal of Mathematics*, **2** (1) (2012), 82–89. **MR2967281**, **Zbl 1278.42041**.
- (47) On stability of Banach frames, *Bulletin of the Korean Mathematical Society*, **44** (1) (2007), 73–81. (with P.K.Jain and S.K.Kaushik). **MR2297696**, **Zbl 1190.42013**.
- (48) On perturbation of Banach frames, *International Journal of Wavelets Multiresolution and Information Process*, **4** (3) (2006), 559–565. (with P.K.Jain and S.K.Kaushik). **MR2260842**, **Zbl 1213.42113**.
- (49) On Banach frames, *Indian Journal of Pure and Applied Mathematics*, **37** (2006), no. 5, 265–272. (with P.K.Jain and S.K.Kaushik). **MR2271627**, **Zbl 1125.46013**.
- (50) Bessel sequences and Banach frames in Banach spaces, *Bulletin of the Calcutta Mathematical Society*, **98** (2006), no. 1, 87–92. (with P. K. Jain and S. K. Kaushik). **MR2218227**, **Zbl 1100.42027**.
- (51) Banach frames for conjugate Banach spaces, *Zeitschrift für Analysis und ihre Anwendungen*, **23** (2004), no. 4, 713–720. (with P.K.Jain and S.K.Kaushik). **MR2110399**, **Zbl 1059.42024**.
- (52) Some remarks in the theory of frames in Banach spaces, *Journal of Analysis and Applications*, **2** (2004), no. 1, 39–50. (with P. K. Jain and S. K. Kaushik). **MR2038296**, **Zbl 1090.42019**.

Conference Papers

- (1) Construction of non-Uniform Parseval wavelet frames for $L^2(R)$ via UEP, In: *Proceedings of Sampling Theory and Applications (SampTA)*, Bordeaux, France, 2019, 3 pp. (with H. K. Malhotra). **Published by the IEEE**.
DOI: 10.1109/SampTA45681.2019.9030867.
- (2) Matrix-valued wave packet Bessel sequences and symmetric frames in $L^2(\mathbb{R}^d, \mathbb{C}^{s \times r})$, In: *Proceeding of the International Workshop on Wavelets, Frames and Applications (IWWFA) III- 2017*, organized by Department of Mathematics, Kirori Mal College, University of Delhi. Published by the *Poincare Journal of Analysis and Applications*, 2018 (2) , 77–96. (with Jyoti, G. Verma, and Virender).
- (3) On weaving fusion frames for Hilbert spaces, In: *Proceedings of Sampling Theory and Applications (SampTA)*, Tallin, 2017, 381–385 (with Deepshikha, S. Garg and G. Verma). **Published by the IEEE**.
DOI: 10.1109/SAMPPTA.2017.8024363.
- (4) On perturbation of local atoms for subspaces, In: *Proceeding of the International Workshop on Wavelets, Frames and Applications (IWWFA) II- 2014*, organized by Department of Mathematics, Kirori Mal College, University of Delhi. Published by the *Poincare Journal of Analysis and Applications*, 2 (2015), 129–137. (with Deepshikha) **MR3439947**, **Zbl 1352.42040**.
- (5) On various types of frames in Banach spaces, *Proceeding of the National Conference on Mathematics of soft computing*, National Institute of Technology (NIT), Calicut, (2012), 109-112.

- (6) On weighted Banach frames, In: *Proceeding of the International Workshop on Wavelets, Frames and Applications (IWWFA) I- 2011*, organized by Department of Mathematics, Kirori Mal College, University of Delhi. Published in the *Communications in Mathematics and Applications*, (Special Issue), 3 (2012), 283–292 (with Shalu Sharma).
- (7) On frames in Banach spaces, In: *Proceeding of the International Workshop on Wavelets, Frames and Applications (IWWFA) I- 2011*, organized by Department of Mathematics, Kirori Mal College, University of Delhi. Published in *Communications in Mathematics and Applications*, (Special Issue) 3 (2012), 313–332.

Research Guidance

(I) The following scholars have completed and got the Ph. D. Degree

- (1) **Geetika Khattar**
Thesis Title: “On the Reconstruction Property and Frames in Banach Spaces”.
- (2) **Saakshi Garg**
Thesis Title: “Weaving Generalized Frames in Hilbert Spaces and Frames in Locally Convex Spaces”.
- (3) **Deepshikha**
Thesis Title: “Weaving Frames in Hilbert Spaces”.
- (4) **Jyoti**
Thesis Title: “Matrix-Valued Wave Packet Frames”.
- (5) **Hari Krishan Malhotra**
Thesis Title: “Nonuniform Wavelet Frames and Nonuniform Multiresolution Analysis”.

(II) The following scholars are currently doing Ph. D.

- (1) **Divya Jindal**
(2) **Uttam Kumar Sinha**
(3) **Manisha Chillar.**
(4) **Ruchi.**

(III) The following scholars have completed and got the M. Phil. Degree

- (1) **Ashok Kumar Sah**
Dissertation Title: “A Study of Irregular Weyl-Heisenberg Frames”.
- (2) **Shah Jahan**
Dissertation Title: “Modular Frames and Riesz Bases in Hilbert C^ - Modules”.*

(3) **Salaj**

Dissertation Title: “A Study of Finite Frames in Hilbert Spaces”.

(4) **Sulbha Kumar**

Dissertation Title: “Geometric Means of Positive Definite Matrices” (jointly with Dr. Tanvi Jain, Indian Stat. Institute, Delhi).

(5) **Soni**

Dissertation Title: “Wavelet Frames and Multiresolution Analysis on Local Fields”.

(6) **Neha Sharma**

Dissertation Title: “Duality of generalized frames in Hilbert spaces”.

(7) **Rajni Gupta**

Dissertation Title: “Fusion Frames in Hilbert Spaces”.

(8) **Ram Kishan**

Dissertation Title: “Clarkson-McCarthy Inequalities in \mathcal{C}_p ”.

Conference Presentations/Organization

(I) Invited talk/Lecture

- (1) Delivered an invited talk entitled “*Frames of Nonuniform Wavelet Systems*” in the Workshop on Applied Matrix Positivity (Online mode) organized by the International Centre for Mathematical Sciences, Edinburgh during July 19, 2021 to July 23, 2021.
- (2) Delivered an invited talk entitled “*Matrix-valued Frames for Operators in Matrix-valued Signal Spaces*” in the International Conference on Analysis, Algebra, Combinatorics and their Applications organized by Department of Mathematics, Jadavpur University, Kolkata during January 20-22, 2020.
- (3) Delivered an invited talk entitled “*Duality Principles in Wavelet Analysis*” in a National Conference on Advances in Mathematical Analysis and its Applications, organized by Department of Mathematics , PGDAV College, University of Delhi, during November 08–10 , 2019.
- (4) Delivered a talk entitled “Woven Fusion Frames in Separable Hilbert Spaces’ in a National Conference on Recent Trends in Mathematics jointly organized by Bharata Ganita Parisad and Department of Mathematics & Astronomy, University of Lucknow, Lucknow during November 10-11 , 2018.
- (5) Delivered an invited lecture entitled “*Hilbert Frames: A Signal Processing Prospective*” in International Conference on Applicable Mathematics organized by Department of Mathematics, Motilal Nehru College, University of Delhi, Delhi during 19-20 February, 2018.
- (6) Delivered an invited lecture entitled “*The Reconstruction Property of Fractals in L^p Spaces*” in International workshop on wavelets, frames and applications III at Kirori Mal college, University of Delhi, Delhi during 14-20 December 2017.
- (7) Delivered an invited talk entitled “*Weaving Properties of Generalized Frames in Hilbert Spaces*” in International Conference on Applicable Analysis, organized by Department of Mathematics, Shaheed Bhagat Singh College, University of Delhi, Delhi during 08-11 February, 2017.

- (8) Delivered an invited talk entitled “*Discrete Frames of Translates in \mathbb{C}^N* ” in National workshop on Analysis, Differential equations & Applications, at Department of Mathematics & Statistics, M. L. Sukhadia University, Udaipur (Raj.) during 25-27 February, 2016.
- (9) Delivered an invited lecture entitled “*On Wave Packet Frames in $L^2(\mathbb{R})$* ” in International workshop on wavelets, frames and applications II at Kirori Mal college, University of Delhi, Delhi during 24-30 December 2014.
- (10) Delivered an invited lecture entitled “*On Retro Banach Frames in Banach spaces*” in National Conference on Recent Advances in Mathematics NCRAM-2012 at Department of Mathematics & Astronomy, University of Lucknow, Lucknow, during 2-4 February, 2012.

(II) Paper Presentation

- (1) (1) Present a paper entitled “An application of finite sums of frames to the frame algorithm” in the National Conference on Applications of Mathematical Tools in Social Sciences and Sciences (Online) , organized by Zakir Husain Delhi College, University of Delhi, during October 17-18, 2020
- (2) Present a paper entitled “Weaving Frames in Measure Spaces” in Internaional conference on Recent Advances in Pure and Applied Mathematics & 28th Annual Conference of Rajastha Ganita Parishad, at Department of Mathematics & Statistics, M. L. Sukhadia Univesity, Udaipur (Raj.), during 13-14 February, 2017.
- (3) Delivered a talk ”Extension of Bessel Systems to Frames in $L^2(R)$ in Conference on Geometry of Banach spaces and Operator Theory (GBOT) at IIT Kanpur during 26 - 29 March, 2015.
- (4) Present a paper entitled ”Some types of linear combinations of wave packet system in $L^2(\mathbb{R})$ in National conference on emerging trends in mathematical sciences organised by Department of Mathematics, Chaudhary Devi Lal University, Sirsa (Haryana) during March 17-18, 2015.
- (5) Present a paper entitled “Frames for subspaces in a discrete signal space” in National conference on Applications of Mathematics in Engineering and Sciences (AMES-2014) organised by Department of Mathematics, Motilal Nehru National Institute of Technology (MNNIT) Allahabad, during November-29-30, 2014.
- (6) Present a paper entitled “On (Ω, μ) -frames in Hilbert spaces” in National conference on Mathematics (NCOM-2013) at University of Lucknow, Lucknow, during 29-11-2013 to 01-12-2013.
- (7) Present a paper entitled “”On duality of retro Banach frames” 11th Biennial conference of ISIAM at Gautam Buddha University, Greater Noida during 15-16 Dec., 2012.
- (8) Present a paper entitled ” The Dynamics of Banach frames ” in National Conference on Advances in Mathematical Sciences (AMS 2012) , at Motilal Nehru National Institute of Technology, Allahabad, during October 05-07, 2012.
- (9) Present a paper entitled ” On Various Types of Frames in Banach Spaces” in National Conference on Mathematics of Soft Computing at N I T Calicut, Kerla, during 05-07 July-2012.
- (10) Present a paper entitled ” On Banach Frames II ” in International Workshop Wavelets, Frames and Applications at Kirorimal College, University of Delhi, 15-21 December, 2011.

(III) Organization of Conferences/Seminars

- (1) Organized ”National Research Scholars’ Seminar”, Department of Mathematics, University of Delhi on December 28, 2018.

- (2) Organized Symposium on "Frames and Wavelets" in the 33rd Annual Conference of Ramanujan Mathematical Society in the Department of Mathematics, University of Delhi during June 01-03, 2018.
- (3) Organized "Research Scholar Seminar & Annual Conference of the Society of Mathematical Sciences (Delhi)" in the Department of Mathematics, University of Delhi during May 01-02, 2017.
- (4) Organized "National Conference on Algebra, Analysis, Coding and Cryptography" in honor of Prof. Bal Kishan Dass on the occasion of his retirement in the Department of Mathematics, University of Delhi during October 14-15, 2016.
- (5) Organized "Research Scholar Seminar", Department of Mathematics, University of Delhi during February 23-24, 2015.

Talks in FDP

- (1) Delivered a talk entitled "Schauder Bases in Banach Spaces" in the Refresher course on Mathematics/Operational Research/Statistics and Computer Science (IDC) (Online mode) on the theme "Mathematics with an Emphasis on Topology, Analysis and Applications" organized by the Centre for Professional Development in Higher Education (CPDHE), UGC-HRDC, University of Delhi during September 2-15, 2022.
- (2) Delivered a talk entitled "The Matrix Exponential" in the Refresher course on Mathematics/Operational Research/Statistics and Computer Science (IDC) (Online mode) on the theme "Mathematics with an Emphasis on Topology, Analysis and Applications" organized by the Centre for Professional Development in Higher Education (CPDHE), UGC-HRDC, University of Delhi during September 2-15, 2022.
- (3) Delivered a talk entitled "Frames in Hilbert Spaces: An Introduction" in the short term course on Mathematical Analysis and Applications organized by the Department of Mathematics, Indian Institute of Technology (IIT) Roorkee during July 4-08, 2016.

Courses Taught

- (1) **U G Level:** Real Analysis, Calculus, Metric Space, Linear Algebra, Group Theory, Ring Theory, Mechanics, Biomathematics, Differential Equations, Partial Differential Equations.
- (2) **P. G. Level:** Functional Analysis; Complex Analysis; Matrix Analysis; Fourier Analysis; Measure and Integration; General Measure Theory; Frames and Wavelets; Theory of Bounded Operators; Operators on Hardy-Hilbert Spaces.
- (3) **M.Phil./Ph.D. Coursework:** Advanced Frame Theory. Research Methodology.

Professional Activities

(I) Member of Editorial Board for the following Journals.

- International Journal of Wavelets Multiresolution and Information Processing (IJWMIP).
- Mathematical Journal of Interdisciplinary Sciences.

(II) **Reviewer in International Math. Database**

- Reviewer in “The Zentralblatt MATH Database” (Germany).
- Reviewer in The MathSciNet (Mathematical Reviews) (Amer. Math. Soc., U. S. A.)