Abhay Kumar Singh

Associate Professor, Department of Mathematics & Computing, IIT (ISM), Dhanbad

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CONTACT INFORMATION

Department of Mathematics & Computing
Science Block
Indian Institute of Technology (Indian School of Mines), Dhanbad
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India

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E-mail: abhay@iitism.ac.in

DATE OF BIRTH   August 24, 1981

MARITAL STATUS   Married

CITIZENSHIP   Indian

RESEARCH INTERESTS
- Quantum Computing
- Coding Theory
- Post-Quantum Cryptography

EXPERIENCE

Associate Professor   **April, 2021 - Present**
Department of Mathematics & Computing,
Indian Institute of Technology (ISM), Dhanbad, India

Visiting Associate Professor   **May 19, 2022 - July 18,2022**
Department of Mathematics & Computing,
Vietnam Institute for Advanced Study in Mathematics, Hanoi, Vietnam

Visiting Faculty   **October, 2020 - April, 2021**
Indian Institute of Management, Rohtak, India

Assistant Professor   **July, 2010 - April, 2021**
Department of Mathematics & Computing,
Indian Institute of Technology (ISM), Dhanbad, India

Assistant Professor   **September, 2009 - June, 2010**
Department of Mathematics,
Mahatma Gandhi Kashi Vidyapith, Varanasi, India

Lecturer   **March, 2007 - August, 2009**
Department of Mathematics,
UIET, CSJM University Kanpur, India

EDUCATION

Ph.D.   **2007**
Indian Institute of Technology (Banaras Hindu University),
Varanasi, Uttar Pradesh, India Dissertation Topic: *"Characterization of Compressible Modules, Clean Rings and study of the properties of such Modules related with Injectivity"*

M.Sc., Mathematics   **2002**
Banaras Hindu University,
Varanasi, Uttar Pradesh, India
First Division

International Research Collaboration and Funding	• Guided two Ph. D. students jointly with **Prof. Hai Q. Dinh, Kent State University, Ohio, USA**.

- Guided two Ph. D. students jointly with **Prof. Hai Q. Dinh, Kent State University, Ohio, USA**.
- Jointly guided an integrated M.Tech student, Vatsal Jha, with **Prof. Udaya Parampalli, Melbourne University, Australia** on Quantum Coding.
- Offered visiting position in summer 2019 at **Telecom Paris Tech, France** with monthly stipend 2500 Euro per month.
- **Visiting Associate Professor, Vietnam Instiute for Advance Study in Mathematics, Hanoi, May 17, 2022 to July 16, 2022**.
- **Visiting Associate Professor, Department of CSE, University of Melbourne, Australia. Sept. 1 to Sept. 30, 2023**.

AWARDS / SCHOLARSHIPS

- **CSIR-JRF (NET)**
  Mathematical Sciences — 2005
- **CSIR-UGC (NET)**
  Mathematical Sciences — 2004
- **Graduate Aptitude Test for Engineering(GATE)**
  Mathematics, IIT Madras — 2003

SPONSORED RESEARCH PROJECT

CSS construction with Symbol-pair Metric over Finite Field — **Ongoing** *March 2022- March 2025*
Metrics funding scheme of
Science and Engineering Research Board, Department of Science & Technology
Grant Amount: 6,60,000 INR

Design and Analysis of Code-based Public-Key Cryptosystem — **Ongoing** *July 2022- December 2024*
Defense Research and Development Organisation
Grant Amount: 49,89,292 INR

Symbol-Pair Codes over Finite Rings — **Completed** *2017-2020*
Extramural Research (EMR) funding scheme of
Science and Engineering Research Board, Department of Science & Technology
Grant Amount: 15,32,000 INR

Compressible Modules and their Application — **Completed** *2017-2020*
National Board for Higher Mathematics, Department of Atomic Energy
Grant Amount: 4,00,000 INR

Characterisation of Clean Rings — **Completed** *2010-2013*
FRS Scheme,
Indian Institute of Technology (ISM), Dhanbad
Grant Amount: 3,90,000 INR

Clean Rings and Their Application — **Completed** *2009-2010*
University Grant Commission, New Delhi
Grant Amount: 95,000 INR

RESEARCH PUBLICATIONS

1. Bhoi, Siddhartha Siddhiprada, Paramapalli Udaya, and **Abhay Kumar Singh**. "Construction of Multiple Constrained DNA Codes." **Cryptography and Communications Discrete Structures, Boolean Functions and Sequences** *(Springer)* (2024).

2. Bindal, Ekta, and **Abhay Kumar Singh**. "Secure and Compact: A New Variant of McEliece Cryptosystem." **IEEE Access** (2024).

3. Narendra Kumar, Siddhartha Siddhiprada Bhoi, and **Abhay Kumar Singh**. A study of primer design with w-constacyclic shift over $\mathbb{F}_4$. **Theoretical Computer Science**. 960, 113925, 2023.

4. V. Pramod Jha, U. Parampalli and **Abhay Kumar Singh**. *Stabilizer codes and Symbol-Pair Metric are Related*, **IEEE International Symposium on Information Theory** *(ISIT)*, pp. 2969-2973, 2022.

5. Narendra Kumar, Siddhartha Siddhiprada Bhoi, Ruchir Gupta and **Abhay Kumar Singh**. *Sliding window symbol-pair constrained codes for energy harvesting*, **Annals of Telecommunications**, 78, pp. 71-77, 2023.

6. Hai Q Dinh, Atul Gaur, Pratyush Kumar, Manoj Kumar Singh and **Abhay Kumar Singh**. *Cyclic Codes Over Rings of Matrices*, **Advances in Mathematics of Communications**, 2022. doi: 10.3934/amc.2022073.

7. Hai Q Dinh, Narendra Kumar and **Abhay Kumar Singh**. *Quantum Codes over non finite chain rings*, **Cryptography and Communications Discrete Structures, Boolean Functions and Sequences***(Springer)*, 14, pp. 909-923, 2022.

8. Hai Q. Dinh, Sampurna Satpati, and **Abhay Kumar Singh**. *Construction of optimal codes from a class of constacyclic codes*, **Journal of Applied Mathematics and Computing** (2022): 1-17.

9. Hai Q. Dinh, **Abhay Kumar Singh**, and Madhu Kant Thakur. On symbol-pair distances of repeated-root constacyclic codes of length $2p^s$ over $\mathbb{F}_{p^m} + u\mathbb{F}_{p^m}$ and MDS symbol-pair codes. **Applicable Algebra in Engineering, Communication and Computing**, 34, no. 6 (2023): 1027-1043.

10. Pooja Mishra, Chiranjeev Bhaya, Arup Kumar Pal, and **Abhay Kumar Singh**. A novel binary operator for designing medical and natural image cryptosystems. **Signal Processing: Image Communication**, 98 (2021): 116377.

11. M. K. Thakur, **Abhay Kumar Singh**, and Hai Q Dinh. *Symbol-Pair Distance Distributions of Constacyclic Codes of Length $2p^s$ over $\mathbb{F}_{p^m} + u\mathbb{F}_{p^m}$*, **Applicable Algebra Engineering Computing and Communications**, 2021. doi: 10.1007/s00200-021-00534-3.

12. Pooja Mishra, Chiranjeev Bhaya, Arup Kumar Pal, and **Abhay Kumar Singh**. A medical image cryptosystem using bit-level di usion with DNA coding. Journal of Ambient Intelligence and Humanized Computing(Springer), pages 122, 2021.

13. Hai Q. Dinh, Bac T. Nguyen, **Abhay Kumar Singh**, Woraphon Yamaka. *MDS constacyclic codes and MDS symbol-pair constacyclic codes*, **IEEE Access**. 9, 137970-137990, 2021.

14. Hai Q Dinh, Narendra Kumar, **Abhay Kumar Singh**, Manoj Kumar Singh, Indivar Gupta, and Paravee Maneejuk. On the symbol-pair distance of some classes of repeated-root constacyclic codes over a Galois ring. **Applicable Algebra in Engineering Communication and Computing(Springer)**, pages 1-18, 2021.

15. Hai Q Dinh, **Abhay Kumar Singh**, and Madhu Kant Thakur. On Hamming and b-symbol Distance Distributions of Repeated-Root Constacyclic Codes of Length 4ps over $\mathbb{F}_{p^m} + u\mathbb{F}_{p^m}$, **Journal of Applied Mathematics and Computing(Springer)**, 66(1):885-905, 2021.

16. Pooja Mishra, Chiranjeev Bhaya, Arup Kumar Pal, and **Abhay Kumar Singh**. Compressed DNA Coding using Minimum Variance Human Tree. **IEEE Communications Letters**, 24(8):1602-1606, 2020.

17. Hai Q Dinh, Atul Gaur, **Abhay Kumar Singh**, Manoj Kumar Singh, and Woraphon Yamaka. b-Symbol Distance of Constacylic Codes of Length p^s Over $\mathbb{F}_{p^m} + u\mathbb{F}_{p^m}$. **IEEE Access**, 8, 67330-67341, 2020.

18. Hai Q Dinh, **Abhay Kumar Singh**, Pratyush Kumar, and Songsak Sriboonchitta. Cyclic codes over the ring $GR(p^e, m)[u]/\langle u^k \rangle$. **Discrete Mathematics(Elsevier),** 343(1):111-543, 2020.

19. Hai Q Dinh, A Gaur, Indivar Gupta, **Abhay Kumar Singh**, Manoj Kumar Singh, and Ro-engchai Tansuchat. Hamming distance of repeated-root constacyclic codes of length $2p^s$ over $\mathbb{F}_{p^m} + u\mathbb{F}_{p^m}$. **Applicable Algebra in Engineering Communication and Computing(Springer),** 31:291-305, 2020.

20. Hai Q Dinh, **Abhay Kumar Singh**, Sampurna Satpati, and Songsak Sriboonchitta. Symbol triple distance of repeated root constacyclic codes of prime power lengths. **Journal of Algebra and Its Applications(World Scientific)**, 19(11):2050209, 2020.

21. Hai Q Dinh, Poom Kumam, Pratyush Kumar, Sampurna Satpati, **Abhay Kumar Singh**, and Woraphon Yamaka. MDS Symbol-Pair Repeated-Root Constacyclic Codes of Prime Power Lengths Over $\mathbb{F}_{p^m} + u\mathbb{F}_{p^m}$. **IEEE Access**, 7:145039-145048, 2019.

22. Hai Q Dinh, **Abhay Kumar Singh**, S. Pattanayak, and Songsak Sriboonchitta. Construction of cyclic DNA codes over the ring $\mathbb{Z}_4[u]/\langle u^2 - 1 \rangle$ based on the deletion distance. **Theoretical Computer Science(Elsevier)**, 773:27-42, 2019.

23. Hai Q Dinh, Bac T Nguyen, **Abhay Kumar Singh**, and Songsak Sriboonchitta. Hamming and symbol-pair distances of repeated-root constacyclic codes of prime power lengths over Fpm+ uFpm. **IEEE Communications Letters,** 22(12):2400-2403, 2018.

24. Hai Q Dinh, **Abhay Kumar Singh**, Narendra Kumar, and Songsak Sriboonchitta. On constacyclic codes over $\mathbb{Z}_4[v]/\langle v^2 - v \rangle$ and their Gray images. **IEEE Communications Letters**, 22(9):1758-1761, 2018.

25. Hai Q Dinh, Bac Trong Nguyen, **Abhay Kumar Singh**, and Songsak Sriboonchitta. On the symbol-pair distance of repeated-root constacyclic codes of prime power lengths. **IEEE Transactions on Information Theory**, 64(4):24172430, 2018.

26. Hai Q Dinh, **Abhay Kumar Singh**, Pratyush Kumar, and Songsak Sriboonchitta. On the structure of cyclic codes over the ring $\mathbb{Z}_{2^s}[u]/\langle u^k \rangle$. **Discrete Mathematics(Elsevier),** 341(8):2243-2275, 2018.

27. Hai Q Dinh, **Abhay Kumar Singh**, Sukhamoy Pattanayak, and Songsak Sriboonchitta. Cyclic DNA codes over the ring $\mathbb{F}_2 + u\mathbb{F}_2 + v\mathbb{F}_2 + uv\mathbb{F}_2 + v^2\mathbb{F}_2 + uv^2\mathbb{F}_2$. **Designs, Codes and Cryptography(Springer)**, 86(7):1451-1467, 2018.

28. Hai Q Dinh, **Abhay Kumar Singh**, Sukhamoy Pattanayak, and Songsak Sriboonchitta. DNA cyclic codes over the ring $mathbb F_2[uv]/\langle u^2, v^3 - v, uv - vu \rangle$. **International Journal of Biomathematics(World Scientific)**, 11(03):1850042, 2018.

29. Narendra Kumar and **Abhay Kumar Singh**. DNA computing over the ring $\mathbb{Z}_4[v]/\langle v^2 - v \rangle$. **International Journal of Biomathematics(World Scientific),** 11(07):1850090, 2018.

30. **Abhay Kumar Singh**, Narendra Kumar, Pooja Mishra, Manoj Kumar Singh, and Indivar Gupta. Construction of dual cyclic codes over $\mathbb{F}_2[uv]/\langle u^2, v^2 - v, uv - vu \rangle$ for DNA Computation . **Defence Science Journal**, 68(5):467472, 2018.

31. **Abhay Kumar Singh**, Sukhamoy Pattanayak, Amrit Kumar Mahato, and Manoj Kumar Patel. On negacyclic codes over the ring $\mathbb{Z}_p + u\mathbb{Z}_p + \ldots + u^{k+1}\mathbb{Z}_p$. **Open Physics(De Gruyter Open)**, 14(1):200211, 2016.

32. **Abhay Kumar Singh** and Pramod Kumar Kewat. On cyclic codes over the ring $\mathbb{Z}_p[u]/\langle u^k \rangle$. **Designs, Codes and Cryptography(Springer)**, 74(1):113, 2015.

33. **Abhay Kumar Singh** and B M Pandeya. A note on Generalization of Semi Clean Rings. **International Journal of Algebra**, 5(21):1039-1047, 2011.

34. . Shiv Kumar, **Abhay Kumar Singh**, and Samarjit Kar. A Deteriorating Inventory Model with Price Dependent Consumption Rate and Exponentially Declining Partial Backlogging. **Proceedings of the National Academy of Sciences, India Section A: Physical Sciences(Springer)**, pages 18, 2018.

35. Shiv Kumar, **Abhay Kumar Singh**, and Manoj Kumar Patel. Optimization of Weibull deteriorating items inventory model under the e ect of price and time dependent demand with partial backlogging. **Sadhana(Springer)**, 41(9):977984, 2016.

36. Shiv Kumar and **Abhay Kumar Singh**. Optimal time policy for deteriorating items of two warehouse inventory system with time and stock dependent demand and partial backlogging. **Sadhana(Springer)**, 41(5):541-548, 2016.

37. **Abhay Kumar Singh**, Sukhamoy Pattanayak, Pratyush Kumar, and Kar Ping Shum. On quantum codes obtained from cyclic codes over $\mathbb{F}_2 + u\mathbb{F}_2 + u^2\mathbb{F}_2$. **Asian-European Journal of Mathematics(World Scientific)**, 11(01):1850009, 2018.

38. **Abhay Kumar Singh** and Amrit Kumar Mahato. Critically Compressible Modules. **South east Asian Bulletin of Mathematics(Springer)**, 42(1), 2018.

39. **Abhay Kumar Singh**, Narendra Kumar, and Kar Ping Shum. Cyclic self-orthogonal codes over finite chain ring. **Asian-European Journal of Mathematics(World Scientific)**, page 1850078, 2017.

40. **Abhay Kumar Singh**, Amrit Kumar Mahato, and KP Shum. Quasi-coretractable modules. **Asian-European Journal of Mathematics(World Scientific)**, 10(03):1750042, 2017.

41. Sukhamoy Pattanayak and **Abhay Kumar Singh**. Quasi-cyclic codes over the ring $\mathbb{F}_p[u]/\langle u^2 - u \rangle$. **Asian-European Journal of Mathematics(World Scientific)**, 8(04):1550085, 2015.

42. **Abhay Kumar Singh**. Essentially slightly compressible modules and rings. **Asian-European Journal of Mathematics(World Scientific)**, 5(02):1250028, 2012

INVITED TALKS / PAPER PRESENTED

- 2022 May 24: "An Overview of Code-based cryptography", Algebra with Applications Seminar Department of Mathematics Aligarh Muslim University, **Aligarh Muslim University, Aligarh(Invited Speaker)**
- 2022 February 01-07: "Code-based Post-Quantum Cryptography", 20-Hours lecture series for Code-based Post-Quantum Cryptography training, **Department of Research and Defence Organisation. (Invited Speaker)**
- 2021, November 16: "Linear Algebra for Quantum Computing and Quantum InformatiRefresher Course on "Advances in Mathematical and Physical Sciences", **UGC-Human Resource Development Centre, Doctor Harisingh Gour Vishwavidyalaya, Sagar(MP). (Invited Speaker)**
- 2021 October 06: "Post Quantum Cryptography", National Workshop on Computational Intelligence and Blockchain Technology, **National Institute of Technology, Raipur(Expert Lecture)**
- 2021, August 13: "Codes over finite fields applications", Five Day webinar on "Stability Analysis and Cryptography in Engineering", **Department of Mathematics, KPR Institute of Engineering and Technology, Coimbatore. (Invited Speaker)**
- 2021, April 28 - May 02 : "Overview on Code-based Cryptography", e-workshop Recent trends in Information Security and Blockchain Technology, **Department of Mathematics and Scientific Computing, NIT Hamirpur. (Invited Speaker)**
- 2020, December 23: "Finite Field,Coding and It's Applications", Faculty Development Programme on "Applications of Algebra and Number Theory in Network Security", **Mahatma Hansraj Faculty Development Centre, Hansraj College. (Invited Speaker)**
- 2020, December 14-19 : "Challenges and Applications of Cyber-Physical System", AICTE Sponsored STTP 2020, GIET Gunupur. (Invited Speaker)
- 2018, June 07: "Symbol-Pair Constacyclic Codes over Finite Fields", ADMA 2018, **IIT Gandhinagar. (Invited Speaker)**
- 2017, December 13-17: "DNA Cyclic Codes", Short-term course on Coding Theory and Cryptography, **IIT (ISM), Dhanbad. (Invited Speaker)**
- 2017, June 15: "Symbol-Pair Codes over Finite Fields", SAG, **DRDO, New Delhi. (Invited Speaker)**
- 2017, May 17: "A Course on Linear Algebra", Faculty Development Centre, **IIT (ISM), Dhanbad. (Invited Speaker)**
- 2012, May 28: "An Introduction to Real Analysis", Undergraduate Training Program on Linear Algebra and Real Analysis (DST), **IIT (ISM), Dhanbad. (Invited Speaker)**
- 2010, February 21: "Uniquely Clean Ideals", Conference on Algebra and its Application, **Aligarh Muslim University, Aligarh**. (Paper Presented)

	• 2007, December 30: "Essentially Slightly Compressible Modules and Rings", Annual Conference of **BHU, Varanasi**. (Paper Presented)
TEACHING EXPERIENCE	University Level Courses Taught: • Cryptography • Calculus • Complex Analysis • Vector Calculus & its Application • Algebra I • Algebra II • Linear Algebra • Real Analysis • Information & Coding Theory • Quantum Computing • Post-Quantum Cryptography
PH.D. STUDENTS SUPERVISED:	• 2017: Shiv Kumar • 2017: Amrit Kumar Mahato • 2018: Sukhamoy Pattanayak • 2020: Pratyush Kumar • 2020: Narendra Kumar • 2022: Sampurna Satpati • 2022: Madhu Kant Thakur • 2022: Pooja Mishra (Co-Supervised)
REVIEW DUTY	Reviewer of • Cryptography and Communications Discrete Structures, Boolean Functions and Sequences - Springer • Journal of Applied Mathematics and Computing - Springer • Applicable Algebra in Engineering, Communication and Computing - Springer • Information Sciences - Elsevier • Journal of Algebra Combinatorics Discrete Structures and Applications • Discrete Mathematics, Algorithms and Applications - World Scientific • Turkish Journal of Mathematics • IEEE Communication Letter • IEEE Transactions on Information Theory • Designs, Codes and Cryptography • Discreet Mathematics • Indian Journal of Pure and Applied Mathematics • International Journal of Theoretical Physics
ADMINISTRATIVE RESPONSIBILITIES	• Hostel Warden *2011-2014* • Co-ordinator of M.Sc.(Mathematics & Computing) *2013-2022* • Faculty Mentor of 1st year B.Tech *Batch: 2017-18, 2018-19* • Member of Departmental Budget Committee • Invigilation Duty In-charge of Departmental Semester Examination • Member of DUGC *2018 - 2022* • Member of DPGC *Since 2022*