# THE JOURNAL
# OF THE
# INDIAN MATHEMATICAL SOCIETY

**ISSN (Print): 0019-5839**
**ISSN (Online): 2455-6475**

**NEW SERIES**

**Volume 90, Numbers 3-4**
**JULY–DECEMBER 2023**
**(PUBLISHED IN JULY 2023)**

**Editor–in–Chief**
**PEEYUSH CHANDRA**

**Published by the Indian Mathematical Society**
**Co-Published Online by Informatics Publishing Limited, Bangalore**
"Online issues are available at http://informaticsjournals.com/index.php/jims"

**The Journal of the Indian Mathematical Society**
**EDITORIAL BOARD**

**Editor-in-Chief**: Peeyush Chandra, Formerly at Indian Institute of Technology, Kanpur (India)

Sukumar Das Adhikari,
Ramakrishna Mission Vivekananda Educational and Research Institute, Belur (India)

George E. Andrews,
The Pennsylvania State University, USA

Gautam Bharali,
Indian Institute of Science, Bangalore (India)

Pratulananda Das,
Jadavpur University, Kolkata (India)

Erdal Karapinar,
Cankaya University, Ankara, Turkey

Siddhartha Mishra,
ETH Zurich, Switzarland

Gadadhar Misra,
Indian Statistical Institute,
Bangalore (India)

Aparajita Ojha
PDPM Indian Institute of Information Technology, Design & Manufacturing,
Jabalpur (India)

M. A. Pathan,
Formerly at Aligarh Muslim University,
Aligarh (India)

S. Ponnusamy,
Indian Institute of Technology Madras,
Chennai (India)

V. Ravichandran,
National Institute of Technology,
Tiruchirappalli (India)

G. P. Raja Sekhar,
Indian Institute of Technology,
Kharagpur (India)

M. A. Sofi,
J. K. Institute of Mathematical Sciences,
Srinagar (India)

K. Srinivas,
The Institute of Mathematical Sciences,
Chennai (India)

S. K. Tomar,
Panjab University,
Chandigarh (India)

Michel Waldschmidt,
Emeritus Professor,
Sorbonne University, France

Ravi P. Agarwal,
Texas A&M University
Kingsville, USA.

Nayandeep Deka Baruah,
Tezpur University, Tezpur (India).

Sameer Chavan,
Indian Institute of Technology, Kanpur (India).

Amartya Kumar Dutta,
Indian Statistical Institute, Kolkata (India).

S. S. Khare,
Formerly at NEHU, Shillong (India).

Arvind Kumar Misra,
Banaras Hindu University, Varanasi(India)

A. K. Nandakumaran,
Indian Institute of Science,
Bangalore (India).

Seshadev Padhi,
Birla Institute of Technology,
Mesra, Ranchi (India).

Vamsi Pritham Pingali,
Indian Institute of Science,
Bangalore (India).

Dipendra Prasad,
Indian Institute of Technology Bombay,
Mumbai (India).

S. Tariq Rizvi,
The Ohio State Unversity,
USA.

Rajen Kumar Sinha,
Indian Institute of Technology,
Guwahati (India).

K. Sreenadh,
Indian Institute of Technology,
Delhi (India).

S. Sundar,
Indian Institute of Technology Madras,
Chennai (India).

V. Vetrivel,
Indian Institute of Technology Madras,
Chennai (India).

B. N. Waphare,
Savitribai Phule Pune University,
Pune (India).

**Managing Editor**: M. M. Pawar, Formerly C. O. E. at K. B. C. North Maharashtra University, Jalgaon (India)

# THE JOURNAL
# OF THE
# INDIAN MATHEMATICAL SOCIETY

**ISSN (Print): 0019-5839**
**ISSN (Online): 2455-6475**

**NEW SERIES**

**Volume 90, Numbers 3-4**
**JULY–DECEMBER 2023**
**(PUBLISHED IN JULY 2023)**

**Editor–in–Chief**
**PEEYUSH CHANDRA**

**Published by the Society**
**Co-Published Online by Informatics Publishing Limited, Bangalore**
"Online issues are available at http://informaticsjournals.com/index.php/jims"

**Paper Submission:**

The authors should prepare the manuscript in LaTeX by following the, ' Instructions to Authors ' at
https://www.informaticsjournals.com/index.php/jims/ia
The pdf of manuscript should be submitted to the Journal of Indian Mathematical Society online after registration at
www.informaticsjournals.com/index.php/jims/user/register
In case of any problem in submission of manuscript contact at
journal.ims1910@gmail.com

Manuscripts (including bibliographies, tables, etc.) should be typed double spaced in LaTeX. Sections should appear in the following order. Title page, Abstract, Keywords and Phrases, AMS Subject Classification (https://zbmath.org / classification/ ), Text, Notes and References.

While typing in LaTeX, the following Preamble be used:

```
\documentclass[10pt, a4]{amsart}
\usepackage{amsfonts, amssymb, amscd, amsmath, enumerate, verbatim}
\renewcommand{\baselinestretch}{1.2}
\textwidth = 12 cm
\textheight = 19.5 cm
\topmargin = 0.5 cm
\oddsidemargin = 1.5 cm
\evensidemargin = 1.5 cm
\pagestyle{plain}
```

There are no page charges. Authors of the papers published in the Journal will be provided pdf file of the papers.

Copyright of the published articles lies with the Indian Mathematical Society.

This volume or any part thereof may not be reproduced in any form without the written permission of the publisher.

This volume is not to be sold outside the country to which it is consigned by the Indian Mathematical Society.

*Journal of the Indian Math. Soc.*
*Vol. 90, Nos. (3–4) (2023).*

**CONTENTS**


| | | | |
|---|---|---|---|
| 1. | Ajoy Kanti Das, Carlos Granados | Preference intuitionistic fuzzy rough relation and its theoretical approach | 199–212 |
| 2. | Paula Kemp, Louis J. Ratliff, Jr., Kishor Shah | Depth One Homogeneous Prime Ideals in Polynomial Rings Over a Field | 213–232 |
| 3. | Soumen Mondal, Chinmay Ghosh, Sanjib Kumar Datta | On Topological Bihyperbolic Modules | 233–248 |
| 4. | N. Shanmugapriya | Independent vertices inserted graph ofgrid and leftmost child joined graph of a subdivided extreme-sides leave tree are graceful | 249–262 |
| 5. | Sunil Kumar R., Kannan Balakrishnan | Centrality Betweenness in Join of Some Graphs | 263–274 |
| 6. | Garima Pant, Sanjay Kumar Pant | Entire Solutions of Certain Non-Linear Differential-Difference Equations | 275–288 |
| 7. | Biswajit Rath, K. Sanjay Kumar, D. Vamshee Krishna, Ch. Vijaya Kumar, N. Vani | Fifth Hankel determinant for multivalent bounded turning functions of order $\alpha$ | 289–308 |
| 8. | Mohamad N. Nasser, Mohammad N. Abdulrahim | On the faithfulness of the extension of Lawrence-Krammer representation of the group of conjugating automorphisms $C_3$ | 309–318 |
| 9. | Renu, Ramdayal Singh Kushwaha | Projective change between Matsumoto metric and generalized Kropina metric | 319–328 |
| 10. | Yogesh M. Thakkar, Ajay K. Shukla | Some Results Involving The ${}_pR_q(\alpha, \beta; z)$ Function | 329–342 |
| 11 | P. M. Paratane, A. K. Bit | Sensitivity analysis in multiobjective solid transportation problem. | 343–356 |

| | | | |
|---|---|---|---|
| 12. | Arijit Jana | Certain supercongruences deriving from hypergeometric series identities | 357–365 |
| 13. | Satya Prakash Singh, Vijay Yadav | On Certain Basic Hypergeometric Series Identities | 367–374 |
| 14. | Marbarisha M. Kharkongor, Debashis Bhowmik, Dipendu Maity | 3-isogonal planar tilings are not 3-isogonal on the torus | 375–386 |
| 15. | Bouchra Merdji, Ahmed Mohammed Cherif | New types of metrics deformations and applications to $p$-biharmonic maps | 387–400 |
| 16. | Shrawani Mitkari, Vilas Kharat, Manish Agalave | On the Structure of Pronormal Subgroups of Dihedral Groups | 401–410 |
| 17 | Nada Osamnia, Kaddour Zegga, Abdelkader Zagane | Harmonic homomorphisms between Riemannian three dimensional unimodular Lie groups | 411–430 |